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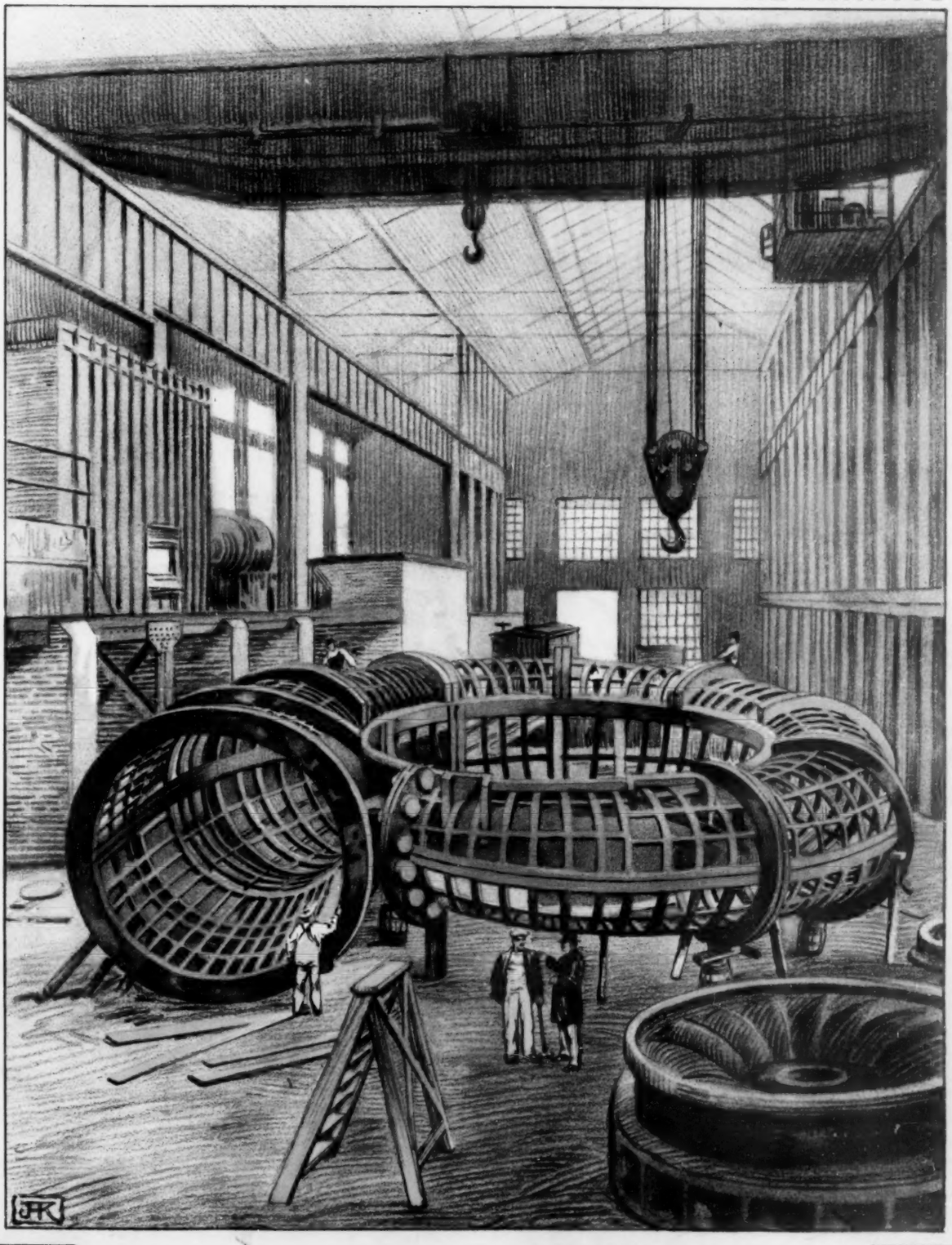
SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



BUILDING A SKELETON PATTERN FOR A WATER-TURBINE SPIRAL CASING.—[See page 189]

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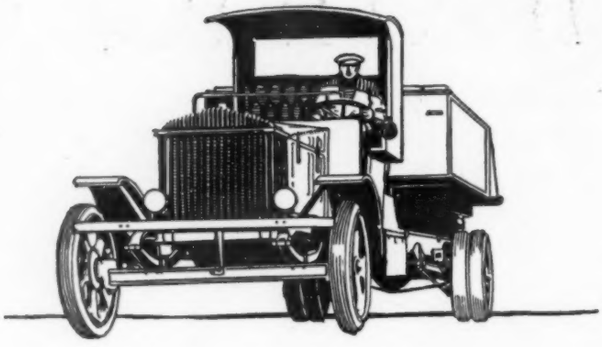

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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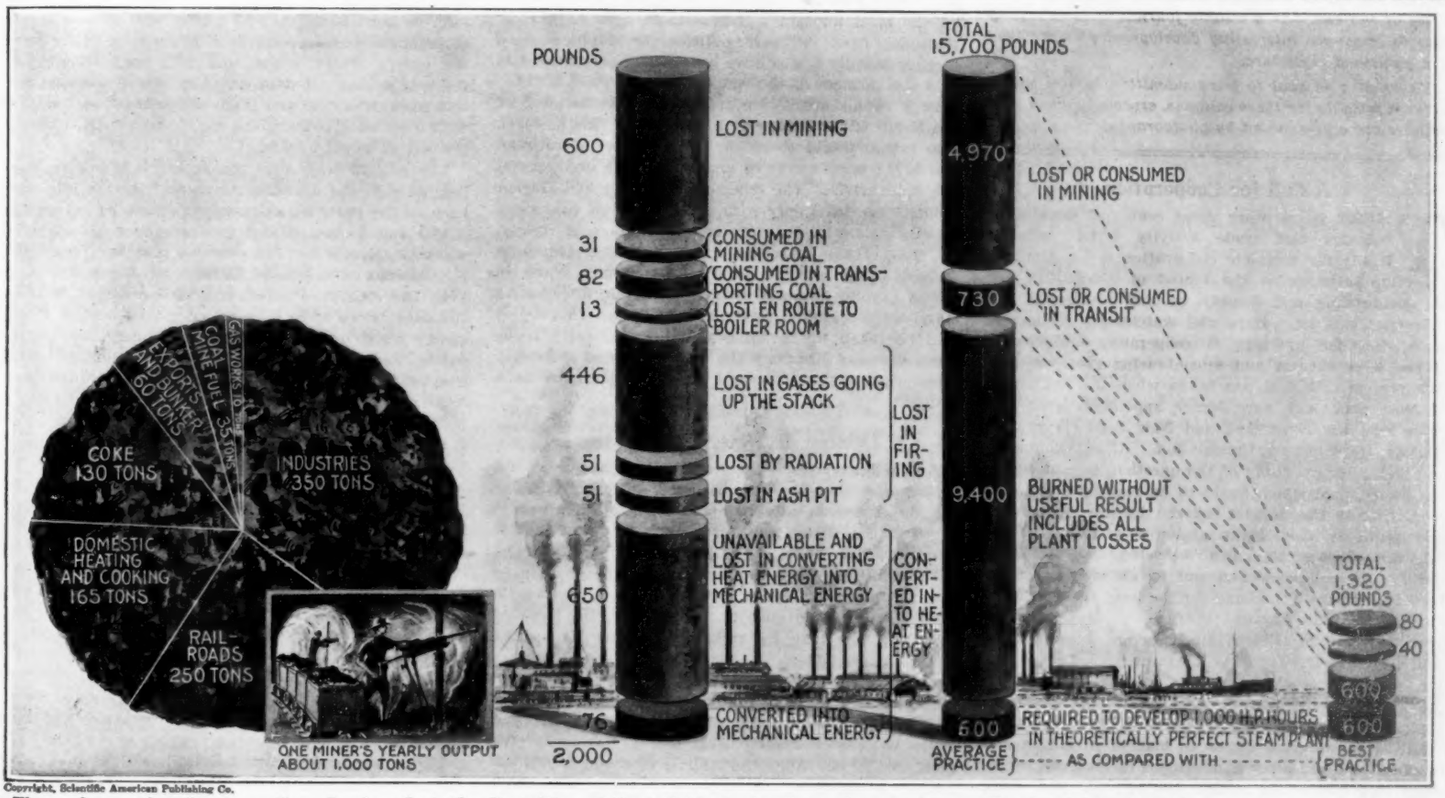

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Three phases of coal consumption, showing, first, the disposition of the individual miner's yearly output; secondly, the eight principal sources or causes of loss; and thirdly, a comparison between average present-day practice and the ideal practice

What Becomes of Our Coal?

HOW many citizens realize just how our coal supplies are being used and to what extent they are being wasted? It is a serious question and one that should have the careful consideration of every large and small employer and also of every householder.

At a recent meeting of an American steel institute, George Otis Smith, director of the U. S. Geological Survey, gave a lucid portrayal of this question which should be fully understood by every citizen. In discussing the question as to what becomes of our coal, he produced a chart, which our artist has picturized at the left of our drawing, revealing the disposition of the individual miner's yearly output of about 1,000 tons. The ball of coal shows the uses to which this 1,000 tons are put including both anthracite and bituminous coal.

In the matter of losses in using coal there are some surprising features. In all there are eight principal sources or causes of loss. The first column of our chart represents these graphically. Under ordinary conditions of mining and firing, out of every 2,000 pounds of steam coal in place in the mine, only about 76 pounds are converted into mechanical energy—a most surprising fact. The other 1,924 pounds are either unavailable or are absorbed by the eight losses shown in the sections of the columns. This means a recovery, as proven, of only 4 per cent of the resource, assuming steady operation. Allowing for further losses due to bad load factor, as is shown in the second column, the recovery, as proven, becomes perhaps 1 to 2 per cent.

In discussing the average and best practice in coal utilization, this authority produced another illuminating chart reproduced by our artist as the second column and third column, comparing the average present-day practice with what is considered the best practice. This diagram shows that to develop 1,000 horsepower, a theoretically perfect steam engine and boiler would require about 600 pounds of coal. Actually under ordinary practice we mine or destroy perhaps 15,700 pounds of coal in the seam in order to develop the 600 pounds of energy. The best practice does the same work with about 1,320 pounds of coal. In other words, the best practice uses only a tenth or a twelfth as much as the average. The losses in average practice here shown are calculated as in the first column, except that in this case allowance is made for the additional loss due to bad load factor.

Honeycombs of Aluminum

THE uncanny instincts of the honey bee, marvelous as they are, can be matched by man with human ingenuity which insures much more efficient honey production. The instincts of the bee which convert a tree hollow into a hive are as wonderful, if not more so, than the human intelligence which conceived and perfected the modern hive, but the modern hive facilitates the vastly better storing of honey. So is it also with many other details of modern apiary management. The honey bee attains maximum efficiency only under human assistance and control.

A new demonstration of this is a recent invention, the aluminum honeycomb. The honeycomb, for centuries, properly has been a scientific wonder. As a problem in mathematics, its construction would challenge the knowledge of the most erudite. Not tampering with its essential construction, beekeeping years ago introduced the movable frame. Now, the comb itself, made of aluminum, is being supplied to progressive beekeepers.

The aluminum honeycomb, an exact reproduction of natural comb, is constructed by folding back and forth a single strip of crimped metallic aluminum. This is done until enough cells have been formed to fill a standard frame. Then six wires are threaded downward through the folds to bind them into a solid whole. To facilitate disinfecting, small holes connect the cells of the two faces, so that boiling water or live steam can freely pass through.

The aluminum honeycomb has several outstanding advantages. Melting down cannot occur. Immediate storage or egg space is always available. Disease is controlled without loss of fixtures. Danger from moths is minimized. Drones are most effectively controlled.

The natural question arises, how do the bees take to the metal? Some special pains are involved at first. When manufactured, the aluminum combs are given a thin coating of beeswax. Beekeepers use them first as extracting combs, preferably. When introduced for brood rearing purposes, the beekeeper employs combs which have already been used by the bees, and an aluminum comb is alternated with a natural comb. The best time to start bees on the combs is during a good honey flow.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Call for Coöperation

THERE is no other great center of population, industry and trade activity which calls so loudly for complete coöperation in handling its collective interests as the Island of Manhattan and its surrounding and densely peopled residential and industrial district. Here the watchword of success in solving the problem, is coöperation—coöperation of the most earnest and all-embracing type. A long step toward this goal was taken when the two states of New York and New Jersey appointed, some two years ago, the New York and New Jersey Port and Harbor Development Commission. After exhaustive and highly expert study of the question, a joint report has been issued which ought to be read by every citizen living in the district covered by the report, and this means by about eight million people.

If this great problem is to be solved in a workable fashion, so that passengers and freight may be transferred in the least time and for the least cost, we must realize that the physical obstacle to transportation presented by the Hudson River is not necessarily a political obstacle. Hitherto it has prevented municipal and state coöperation; so, also, in less degree, have the waters of the Harlem, the East River, and New York Bay.

Hitherto, concerted action in matters of transportation has been somewhat handicapped by sectional prejudices and differences within the city of New York itself; while on the New Jersey side of the river, the political subdivision is represented by more than forty separate municipalities, ranging from Newark, a city of nearly half a million inhabitants, down to small boroughs and townships. Hitherto, these multiplied interests have pulled in as many different directions. If we are to solve the problem of this port, they must pull together. *E pluribus unum* as a motto is as fundamental a necessity here as it is in its broader national significance.

Never, as the report states, has there been any general comprehensive plan for the terminal development of the port considered as a whole, to which all parties interested have subscribed or toward the realization of which all interests, municipal and private, have coöperated. The urgency of the matter is realized when we remember that some eight million persons live within 25 miles of the Statue of Liberty, and that about fifty per cent of the foreign trade of the United States passes through this port. All of these people, the report reminds us, must have food and all help to pay the millions of dollars wasted annually through inadequate market facilities, lack of economical means of local transportation of foodstuffs, and the resultant excessive handling, excessive trucking, and excessive exposure to the elements. All wear clothing, and all share in the high expense of delivering either finished products received from elsewhere or raw materials used here in manufacture. Housing, we do not have to be reminded, is an acute problem, and the inadequacy of terminal facilities for handling building materials discourages new construction. Occasionally, marine and other strikes cut off the flow of food stuffs. The weather, too, plays its part. Coal is frozen in cars in the Jersey yards; ice jams prevent free movement of coal barges, so that although there may be much coal within the district, transit and lighting companies have been threatened with shutting down for lack of fuel.

But in addition to the eight millions within the metropolitan district, there are about six millions in New York and New Jersey beyond the limits of the district. They, too, pay part of the burden of inadequate terminals at New York. For this port is a primary distributing center for places as remote as Buffalo and Atlantic City. The problem has also a national aspect. The trade of the whole world has settled upon New York as the natural gateway between the interior of the United States and itself. Nearly all the most important transatlantic lines have their terminals here. Proper facilities for shipping grain through this port, which we have not at present, would help the farmers of the country.

In a recent article we referred to the building of the North River Bridge as a solution of this problem. The bridge would cover the whole phase of railroad and rapid transit service and automobile and general vehicular traffic. The scheme of the Port and Harbor Commission deals only with one element of this great question, namely, that of the distribution of freight, the food stuffs and miscellaneous lighter merchant freight being brought from a distributing yard in Jersey City by means of tunnels to certain distributing warehouses scattered throughout the city. This report will be taken up in fuller detail in an early issue, when we shall illustrate the very novel and extremely interesting method proposed by the Commission as a solution.

Decline of American Aviation

IT is best to look facts squarely in the face and realize that there has been a deplorable decline in American aviation since 1918. Equally true is it that although the future lies in the hands of Congress, that body has done very little to stop the debacle. If Congress shows a helpful attitude, passes the necessary legislation and provides a reasonable appropriation, this country, which saw the birth of aviation, will take its rightful place as its leading modern exponent.

Immediately after the Armistice, American aeronautics consisted in the United States Air Service of 21,000 officers and 175,000 men, and in Naval aviation there were over 3,000 officers and 47,000 men. We possessed 15,000 American built planes and 20,000 engines. Invested in the airplane industry was about 100 million dollars of capital, and the force of employees, including the spruce force, included 250,000 men and women. Today, the United States Air Service consists of 1,090 officers and 8,343 men; and in Naval Aviation there are 624 officers and 4,627 men with aviation rating. Our equipment consists of obsolete war material and a few hundred experimental aircraft and engines. As to the industry, plants allied with the aircraft industry during the war have reverted to their original lines of business, and the capital remaining in this industry has shrunk to 10 million dollars or less. It is doubtful if the employees all told number 2,000.

Immediately after the Armistice, our allies undertook the encouragement of civil aernautics as the surest and most economical means of providing national security in the air. They did this by the passage of sympathetic laws regulating aerial traffic; by provision against dumping of obsolete foreign aircraft; by the establishment of air routes and terminals; by the development of the air mail; and lastly by recognition of the fact that the aircraft industry cannot survive if the Government compete with it in the production of planes and engines. Hence, our allies limit work in Government shops to experiment and research, and depend upon private industry for the development of design and all manufacture and procurement.

Except for the establishment of the Air Mail Service, Congress has done but little for the industry in this country, and it has rewarded the fine results achieved in our Air Mail Service by cutting down the modest sum asked for its continuance and improvement. Every citizen is, or should be, interested in this question, and he should make it his duty to impress upon the minds of the Senators and Representatives from his district that he is concerned in seeing the airplane industry stimulated by liberal Federal support.

Jane's Fighting Ships

THERE is probably no book devoted to naval affairs that is more widely known than the naval annual entitled "Jane's Fighting Ships," which was founded in 1896 by Fred T. Jane and is now edited by Oscar Parkes, who is well known as a contributor to SCIENTIFIC AMERICAN readers by his illustrative and descriptive work, and by Maurice Prendergast. The 1920 volume is a comprehensive work of 577 pages, and like its predecessors is distinguished by the great extent and detail of its naval information. It contains a photograph or a diagram of practically every warship of importance in the various navies of the world, and with each illustration there is a mass of data affecting the armament, motive power and date and place of construction, together with a series of notes which will be welcomed by every student of naval affairs.

The editors state that the recent issues have been hampered by the disabilities arising from the late war, such as the partition of ex-enemy warships among the Allied and United States navies; the nomination of warships chosen for the German post-war fleet; and the disposal of unfinished German naval vessels.

In the British, French and Italian naval sections full-page tables have been added giving details of ex-enemy warships received by each country for "propaganda and experimental purposes." Similar paragraphs have been added to the United States and Japanese naval sections. These vessels are to be broken up, or destroyed under experimental tests, and they do not constitute an addition to the strength of the navies of the powers to which they have been allotted. Hence, in this annual there will be found no illustrations and descriptions of these ex-enemy vessels. The same considerations account for the total abolition of the former Austrian Navy section.

An important improvement relates to the dates attached to photographic illustrations. These dates give approximately the year of the first commission of the vessels, or they give the edition of the annual in which the views first appeared. Also, the matter of torpedo craft plans has been thoroughly investigated and diagrams have been added of all modern types of destroyers and torpedo boats, wherever they could be secured.

Under the head of Great Britain will be found, for the first time in this annual, photographs that cover the entire page. This has been rendered necessary by the rapid growth in size of the modern battle-cruiser; for the ordinary photograph, five inches in width, is found to be inadequate to depict clearly the details of these great ships. Consequently, we find that the photographs of such ships as the "Renown" and the "Hood" cover the full 10-inch width of the page, as do also the outboard profiles and deck views of these ships.

The silhouettes of United States warship types include this year a considerable number of new official drawings, while the ship pages comprise plans of all the most modern types now under construction. These United States photographs were placed at the disposal of the editors by the United States Naval Recruiting Bureau. Due attention has also been given to the important subject of the establishment of naval bases required by the new United States Pacific Fleet.

Japan also receives special attention this year, including new and exclusive information as to the past and projected expansion of the "Imperial Navy." A unique feature is the collection of photographs of the Japanese submarines, the first of its kind ever published. Novelty is given to the sections of France and Italy by the addition in this issue of various ex-German and ex-Austrian warships which are given under their new French or Italian names. Under the Italian section will be found photographs of those most interesting vessels, the "Italian Mobile" Batteries which were called into existence during the war and played such an important part therein.

Electricity

Electric Traction on Canals is being discussed extensively in France, at present, in view of the large volume of traffic which these waterways are to handle in the no distant future. The suggestion has been put forward that the St. Quentin Canal be supplied with electric current by an overhead trolley wire, and that special electric tractors be employed to haul the barges through the locks. One of the several electric tractors being experimented with will soon be illustrated and described in our columns.

Venezuela's Radio Plans.—A definite program has been established by the Venezuelan Government for the installation of twenty-two secondary wireless stations. Contracts have already been awarded to an American citizen for installing wireless towers at the following points: Maracay, San Cristobal, Maracaibo, Puerto Cabello, Coro, La Guaira, and Ciudad Bolivar. The station at Maracay has been equipped with a five-kilowatt set purchased from an American concern, and orders have been placed with American concerns for three other 5- and one 3½-kilowatt set.

Errors in Radio Direction Finding are believed to be due to two causes: First, deviation of the waves in their passage through space; secondly, local interference at the receiving end. The first cause is probably incurable, according to a recent issue of *Radio Review*, but the second is now being investigated. It is pointed out that in practical work attention is concentrated on eliminating errors rather than on investigating them, and observers are asked systematically to collect data of such phenomena for investigation. Local errors are roughly grouped under four headings: 1. Masses of metal, especially iron. 2. Large conducting or partially conducting surfaces. 3. Tuned circuits, and 4. Long-distance telegraph and telephone lines.

A **Mercury Contactor** that fits into fuse clips has been placed on the market by an American manufacturer. This forms a hermetically sealed circuit-breaking device which can be used as a switch or to make and break an electric circuit rapidly. The contactor consists of a glass tube containing a quantity of mercury, an inert gas and two central electrodes with a gap between. The electrodes are connected to outside brass caps at each end of the tube. The simplest type of these contactors is operated by being tilted so that the mercury makes and breaks the circuit between the electrodes. In the relay form of construction the necessity of tilting is eliminated by the use of a hollow iron cylinder which is lined with an inner sleeve of porcelain. The gap between the electrodes is inside of the iron cylinder.

Gases for Electric Lighting.—In a recent paper read before the American Institute of Electrical Engineers, D. M. Moore traces the early development in the use of luminiscent gases as sources of light leading to the Moore tube systems containing nitrogen and carbon dioxide. Such systems operate at a pressure of several thousand volts. The introduction of neon on a commercial scale enabled much smaller tubes to be used. Lamps with a 3-m. gas column will operate on 220 volts at about 0.5 watt per candle-power without any transformer, but some starting device is necessary. However, a type of neon lamp has now been developed experimentally which will fit into an ordinary glow-lamp holder on a 220-volt circuit, and requires no starting device. Such lamps depend on the utilization of the negative glow, and yield a yellow light of about 1 candle-power at present consuming about 15 watts per candle.

Increased Use of Electric Service.—Some very pertinent remarks were recently made by Donald McDonald, vice-president and general manager of a gas and electric company of Louisville, Ky., in the course of an interview. He says in part: "There is a bright side to the public utility situation created by the war. Users of power have had their attention called to the certainty and reliability of central-station service. With coal at famine prices and difficult to get even at these prices, power users have turned more and more to electric service; the result has been an enormous increase in the output of electricity for power. Even in the field of domestic lighting people have found that plenty of light in their homes means a great deal in the way of comfort and comparatively little in the way of cost. These conditions will remain after the causes which brought them about have passed away. Cost of operation is slowly, but surely, coming down, while people who have become acquainted with the luxury and convenience of electricity will continue to use it much more generously than they did in past years."

Science

Caterpillars As Food.—At a recent meeting of the Entomological Society of America, Mr. J. M. Aldrich of the National Museum stated he found a small tribe of Mono Lake Indians which caught and dried a ton and a half of caterpillars in a season for food.

Death of Prince Kropotkin.—It is not often that a man of science occupies the rôle of revolutionary leader. This is the case with Prince Peter Alexeivitch Kropotkin who has just died. He was a great Russian geographer and writer on natural history subjects, but twas a proscribed Nihilist as well. He had a most picturesque existence and was identified with all kinds of plots and revolutions. He wrote many scientific articles for English reviews.

Approaching Visit of Madame Curie.—The foremost woman scientist, Mme. Curie, who with her husband discovered radium, will visit this country in May, to receive in person the Willard Gibbs gold medal, which no woman has ever before received. Incidentally, she will be presented with the desire of her heart for "a gramme of radium all my own." The women of America will make the present unassisted by donations from men. The market price is now about $130,000.00 a gramme.

The First Whale with Hind Legs has been caught in British Columbia. This was described at a recent lecture held at the American Museum of Natural History. The legs project some four feet from the body near the tail, and are about six inches broad, the bones being covered with a thick layer of blubber which may or may not have contained muscle. The whale, a female fifty feet in length, was unfortunately not preserved at the Victoria whaling station, where it was brought in, and one of the legs was broken off by those making the capture.

Carbon Black under a Cloud.—It is strange that one of the lightest and blackest substances known should be under a cloud, even if a legal one. This valuable substance which makes printing possible, which makes rubber tires comparatively cheap and which makes our fountain pens black, is seriously menaced by laws and legislators in a number of States in the natural gas belt. These astute gentlemen have suddenly discovered that the country is going to ruin, owing to the wasteful use of natural gas in producing carbon black, and in Wyoming the penalty is $1,000 a day for attempting to make the fluffy pigment, which was described a few weeks ago in our columns.

Telephone Pole Specifications.—At the request of the Overhead Systems Committee of the National Electric Light Association the Forest Products Laboratory is collecting data on the taper and strength of various pole species including: Southern Yellow Pine, Chestnut, Western Red Cedar and Northern White Cedar, in order to check up, or, if need be, revise their standard specifications for poles. Data are also being collected on the efficiency of various treatments commonly used for poles. These data are based on the results of service tests by the Forest Products Laboratory that have extended over a period of approximately 14 years.

Prevention of Wood Borers.—A special survey is being made of conditions in San Francisco Bay where marine borer depredations are very serious just now and causing excessive damage. A representative of the U. S. Forest Products Laboratory is carrying on the investigation in coöperation with a local committee. It is expected that the San Francisco study will require about three months, and that the data obtained will be of considerable value to engineers who are concerned with the construction or maintenance of marine structures. An investigation on the prevention of marine wood borers has been very much needed for years but due to lack of funds it has been impossible to make satisfactory progress.

Currents in the Maine Gulf.—Some interesting explorations have recently been made in the so-called Gulf of Maine. 330 drift bottles were set out in the bay and 16 of these bottles were picked up off the shores of the Gulf of Maine. Each bottle contained a Canadian post card to be sent to the Biological station with the offer of a reward to the finder who wrote the time and place of finding and posted the card. The larger bottles had a galvanized iron drag which was attached so that the bottle was hung at a depth of 3 fathoms. This was done to minimize the effect of the wind. Seven out of the 11 bottles which went to Cape Cod were found between seventy and eighty days after being sent out. The distance from the Bay of Fundy is about 300 nautical miles; therefore, the rate of drift was 4 nautical miles per day. There was a map of the course of the drift bottles published in a recent issue of *Science*.

Aeronautics

Utilizing the Marshes as Landing Fields.—A recent suggestion to utilize the marshes as landing fields comes from Joseph A. Steinmetz of Philadelphia. His suggestion calls for the stretching of a strong net over the ground upon which the airplane is to move.

Whale-Spotting from the Air.—A group of adventurous British airmen is about to demonstrate how airplanes may be used to advantage by whaling companies for whale-spotting. It is believed that the advantages of aerial spotting would greatly augment the efficiency of whaling fleets and in this manner more than compensate for the expense of the air service.

Mathematically Correct?—From a report received in Paris from Berlin, it appears that up to November 3rd the Inter-Allied Aeronautic Commission had taken possession of 28,000 aero-motors—that is, 12,000 more than the Germans said they possessed. The Commission is also said to have confiscated 18,000 machines, these being, it is understood delivered in accordance with the terms of the armistice.

Rain by Airplane.—Following the report of experiments in the Transvaal to produce rain by an airplane dropping dust on the clouds comes word from Winnipeg of another scheme with the same end in view. The Canadian scheme calls for the spraying of liquid air in the clouds in order to cause the condensation of the moisture in the atmosphere. Truly, these schemes are very much like our old friend, the rain producing and anti-hail cannon, in somewhat new dress.

The Danger of High Speeds.—De Romanet had a very narrow escape recently when trying to beat his speed record of 292.68 km. per hour made previously on the same day. His engine was just "reviving" when the "fairing pot" in the airscrew broke, bursting his airscrew, the débris damaging his bottom plane, undercarriage and radiator. Any pilot without his ability would certainly have been killed, as he was doing well over 180 miles per hour at the time.

A Projected Atlantic Flight.—The Minister of War, Dr. Moreno, has informed Capt. Zuloaga of the impossibility of the Government helping his projected flight from Puerto de Palos (Spain) to Buenos Aires, on account of the lack of the necessary materials for carrying it out. On account of this reply Capt. Zuloaga went to the Ansaldo Co. and asked them for the loan of a machine, having already obtained leave for the necessary time to carry out his project. He is convinced that, once having obtained the machine, a public subscription will be raised.

Fast Mail Time.—On February 23rd the United States Mail Service broke all records for fast mail between San Francisco and New York City, when an airplane reached Mineola with seven pounds of mail. The distance covered was over 2,700 miles, and the actual time 33 hours and 20 minutes, or twice as fast as mail has ever been carried between the two cities by the air route. Night flying made the record possible. Jack Knight of Cheyenne, Wyo., carried the mail through the night, steering by compass, between Omaha and Chicago. Although the route was new to him, he flew over the 1,000-mile course and landed safely.

The Antwerp Airdrome.—Although some 1,200 passenger flights took place during the summer, and more than 100 passengers embarked at Antwerp for London or Paris, the Antwerp Airdrome has been closed and the airplanes and all material have been shipped back to Evère. The 4th Military Flight Squadron is now in possession of the site. With this blow to all energetic aviation enthusiasts in Belgium, more particularly to M. Jean Olieslagers, the devoted defender of Antwerp's air port, the projected Antwerp-Strasbourg line and the improvements in the British and French Air Mail, are now things of the past. Its memory merely remains to show that the spirit of procrastination and the colossal lack of initiative and foresight prevails not less in Belgium than it does in other countries.

The Stout Aerial Sedan is the outcome of the Stout monoplane which was designed during the latter part of the World War and for which great things were predicted. The airplane is the design of W. B. Stout of Detroit, Mich. It is fitted with one of the new 200-horsepower Packard airplane engines, and with this power plant carried a greater load at higher speed and for longer distances than any previous American-built plane of twice the horsepower. It is a real commercial three passenger limousine, built entirely of veneer, including wings which are internally trussed and completely covered with veneer. The plane is claimed to be nearly twice as strong as former types of airplanes, and yet weighs only 1,820 pounds. Its maximum speed is in excess of 125 miles per hour, while its landing speed is less than 45 miles per hour.

Who Shall Work the Farms?—I

The Record of Last Year and the Prospects for 1921

By G. H. Dacy

Where the overall movement finds its most practical application

ONE out of every four farm hands in the country has disappeared according to official reports of the Department of Agriculture, which show that the present supply of hired farm labor is 15 per cent less than last year and approximately 72 per cent of the normal supply. The chances are that the hired help deficit exceeds this figure as the Federal agricultural authorities are always very conservative and never circulate anything but the most conservative data relative to farming conditions. Without question the farm labor famine of 1920 was as serious as that of the summer of 1918.

The Secretary of Agriculture did all in his power to recruit the farm labor resources of the country and to mobilize the 24,000-odd students at the 48 agricultural colleges as well as the untold thousands of business and industrial workers—who rather than face a pronounced curtailment in food production were again ready to engage in emergency harvest work—for crop production and salvage work.

The Department addressed appeals to the various colleges, civic organizations, rotary clubs, commercial clubs and similar organizations urging them to lend all possible aid so that the American bread basket and ment hamper might be as full as ordinarily when cold weather again sets in.

"The farmers and their families will always exert every effort to maintain production," reported Secretary Meredith, "but they are without the hired help which they ordinarily have had. In consequence the food harvest may be mens urably reduced unless others give assistance. Of course one with little or no farm experience should not expect to earn as much at first as a seasoned hand but in a few weeks practically all men and boys who are adaptable, alert and strong should be qualified to earn good wages in the harvest fields. The demand for farm labor has induced a considerable increase in the level of farm wages. This increase, however, does not permit the farmer-employer to compete on equal terms with the industries, but a man or youth spending his summer on the farm is in position to save a larger proportion of his wages than if he were working in the city.

"Unquestionably there is manpower available in the schools, towns and cities sufficient to materially relieve the farm labor situation. I believe that men throughout the country at large will respond when they learn how critical are the conditions, and so afford another practical demonstration of the neighborly and coöperative spirit which characterized the efforts of the people during the war. Many men have relatives or friends in the country to whom they can offer their services; others who are interested should write to the director of agricultural extension at their State agricultural college, stating the time at which they will be available and their qualifications. The director will put them in touch with county agents who know farmers in need of help."

A Pennsylvania landlord and farmer who owns and operates more than 50 farms and who has been engaged in farming for over half a century told me that his solution of the farm labor shortage is greater field efficiency on the part of the available working forces and longer periods of service in the field. He spoke at length of one of his tenants who last year handled 500 acres of farming land with one additional man and a boy, a force which ordinarily was kept busy on one 200-acre farm. All the crops were saved because the men and boy worked as long as light lasted during the rush of the growing and harvesting seasons and also because good management was practiced in handling the place. "The trouble with farm labor—tenants as well as owners—is that they do not work so hard as they formerly did. Probably the national unrest and discontent apparent all over the world has also effected them," is the way this man sums up the situation.

AMERICA has a great habit of leaving its problems to solve themselves. We admit the existence of a grave question that presses for an answer; we discuss it in high places and get more or less widely worked up over it; we clamor for a legislative rubbing of the lamp of Aladdin which shall make the trouble magically fade into nothing; and then we go on about our business and leave it to chance and the slow natural working of the law of supply and demand to unravel the kinks. Sometimes this policy of letting things slide to a natural angle of repose works admirably. Sometimes, however, it leads to disaster, or close to disaster. Mr. Dacy has given a careful consideration to the farm-labor problem as it was revealed by 1920, and as a result of this is concerned to know where we are going to get our food supply in 1921—or perhaps, passing this year in safety, where it will come from in 1922, or in 1923. In the present article he establishes, we think, the serious character of the situation and the improbability of meeting it successfully by any of the obvious remedies. In a second article, in a later issue, he will attempt to put forward some constructive suggestions. — THE EDITOR.

On one of the best equipped farms in the country—a large place provided with every conceivable kind of modern labor-saving appliance—six tractors were harnessed daily from sunup to sunset trying to maintain normal cropping activities despite the paramount handicap of a limited labor supply. Two of these tractors have been operated by mere striplings, one a lad of ten years, the other a boy of fourteen, while the other implements in the battery have been manned by men. On an adjoining farm a boy barely eight years old daily throughout the season drove a four-horse team, riding one of the horses and harrowing and dragging the land as rapidly as his father and older brother could plow it.

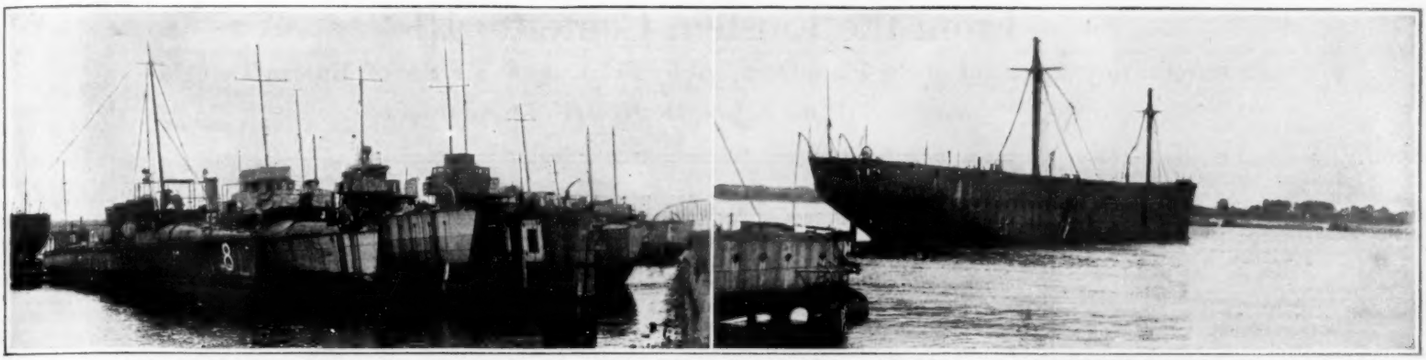
One who traveled the Corn Belt and Middle Western States last summer saw unusual and interesting sights where the agricultural activities are the thickest. More field work was performed on Sunday than ever before—not that the farmers of that section desire to violate the solemnity of the Sabbath but because they appreciated that only by the intensive employment of every minute of available daylight would it be possible for them to plant, cultivate and harvest the maximum acreages which they would be able to handle with their restricted working forces. On nearly every farm it was a case of "work, work everywhere and only a few to do it." The unseasonable and late spring operated to increase the intricacy and complexity of the average farmer's problem of keeping pace with the calendar of his work.

It was common to see a boy driving one team—hitched to a drag for instance—and leading another team pulling a disk harrow or peg-tooth harrow. Every available tractor was worked to its limit daily; the double and tandem and triple hitches which permit of moving two or three different farm machines and of practically preparing a seedbed in a single passage of the outfit over the field were more popular than ever as means of combating the scarcity of manpower. Commercial fertilizers—which permit of vitally increasing the acreage yield of the various staple crops—were purchased in large amounts despite their high prices. Farmers in general said: "We much curtail our cultivated acreage because we are shy on sufficient help but we will do our best to make the highest yields possible on the areas which we are able to crop."

The meager returns concerning the agricultural census which are available at this writing indicate that there has been a decided increase in the populations of towns and cities—especially in manufacturing and industrial sections—at the expense of the rural populations in the contiguous regions. The lure of shorter hours, proximity to the bright lights and higher wages have resulted in a marked exodus citywards from the country districts. Right now there are 25,000 idle farms in New York State. Alabama reports that 1,000,000 acres of fertile farming land which previously have been tilled are running rampant to weeds, filth and unproductive debility. The agricultural commissioners of Connecticut, Vermont, New Hampshise and Massachusetts announce 100,000 idle farms within their borders. Even Iowa—one of the richest, most progressive and reliable producers in the United States—shows a three per cent fa-

(*Continued on page 195*)

Volunteer wheat threshers at Lexington, Ky.; the entire crop from 250 acres was threshed by volunteers



Old torpedo boats waiting in the marine junk-yard at Philadelphia to be refitted as fruit carriers, and the old British troopship "Terror"

Salvaging Torpedo Boats for Peaceful Uses

By William A. McGarry

A PRACTICAL use for the speedy little wasps of the sea that were considered the last word in torpedo boat construction twenty years ago, but are now outclassed, has been found at a Delaware River shipyard which is probably the largest marine junk shop in the world. Thirteen destroyers named after famous American Naval heroes are now tied up at the docks of this plant, and five of them are being converted into cargo carriers and will go into service between Atlantic Coast and West Indian ports within a few months.

Heretofore, when a torpedo boat reached the end of its value as a naval unit because of age or rapid developments in naval architecture, it was stripped of armament, instruments and machinery and tied up in some back channel to rust until sold for junk. As a matter of fact, the thirteen destroyers now at the Delaware River yard were sold for their scrap value. No one had ever succeeded in finding any commercial use for one of the narrow, fast little craft. Attempts had been made to utilize them as yachts, but they were unsatisfactory as their hull lines were never drawn for comfort.

But now it has been determined that because of peculiar conditions existing in the fruit trade it has been found feasible to convert five of the destroyers for this service. The average mean draft of the vessels in fighting trim was about six feet, and the length is from 245 to 260 feet with 23 to 25 feet breadth. Armament was light from the viewpoint of the ordnance expert, but it ran into many tons. Likewise, the machinery that gave the vessels their great speed filled the larger part of the space below decks.

It has been estimated that with this machinery and armament removed it will be possible to load several hundred tons of miscellaneous freight into the hull space that will be available. This tonnage is extremely small for a general freight carrying business, but in fruit it is expected to pay. The idea is to eliminate the present heavy lighterage charge, to which virtually all the steamers of the existing fruit fleets are subject, by running the converted destroyers into streams and inlets right up to the plantation docks, now reached only by the lighters. In addition to the direct saving of labor thus attained, this will mean a considerable saving in loading time and will make possible a larger number of trips in any given period.

The vessels will operate with a small crew. Details of the machinery to be installed are not as yet available. It will be based, however, on a power plant to consist of an oil burning engine of the Deisel type which will be located well aft, and which will take up relatively little space. Since the boats are to be kept in coastwise service and the trips will be short, it will not be necessary to devote a great deal of space to the oil tanks. Yet it is believed that because of the slender lines of the boats relatively high speed will be possible, even with a light engine.

It is likely that the eight boats remaining after the five are converted will be held until a thorough test is made of the practicability of the new plan. If it proves successful the other boats will be put into the same service. All of them are being stripped of their machinery, which is of no use except for high speed and is too expensive to operate. The vessels in the group are the "Stewart," "Bainbridge," "Whipple," "Worden" and "Truxton," now being converted, and the "Perry," "Barry," "Dale," "Paul Jones," "Hull," "Lawrence," "Preble" and "Decatur."

The record of any of the thirteen boats is a lasting testimonial to the honesty of the builders and to the excellence of American Naval design and construction. Reference to naval annals will show that the newest of the vessels is eighteen years old. They were all built in the years from 1900 to 1902, yet until the close of the World War each was in active service. One, the "Stewart," was the only American torpedo boat officially credited with sinking a German submarine. In recognition of this feat the vessel was authorized to carry a gold star on one of her funnels. Nearly all carried gold service strips when they were towed up the Delaware River from the League Island Navy yard and thrust their noses into the mud to await the hands of workmen.

Every one who has read of the exploits of the torpedo boat in the World War knows that these craft are of the lightest possible construction—mere pliable shells of steel that seem to bend and give to every wave. When the engines and boilers packed into the hulls from keel to deck plates are operating at top speed the vessels are shaken as a rat is shaken by a terrier. These thirteen ships stood that sort of test off and on for fifteen to seventeen years, which is a fairly long life for a torpedo boat. But just when they might have been retired America got into the war and it became necessary to use every ton of naval fighting force to guard the bridge of ships across the Atlantic,

(*Continued on page 196*)

Copper in Steel and the Corrosion of Cars

By A. R. Surface

THERE has been for several years considerable controversy as to whether the presence of copper in small quantities in steel plates is a preventive of corrosion. To determine whether results would be obtained in the bodies of steel railroad cars and their life prolonged, the Bessemer and Lake Erie Railroad early in 1914 ordered 100 hoppers and 100 gondola cars using both copper-bearing and plain steel plates in the same car body.

It would be impossible to make a true comparison of the two kinds of steel if placed in different cars, as no two cars are used under exactly the same conditions of service. To make this test truly comparative, these cars were built so that the body of each car was made up of half copper-bearing steel and half plain steel.

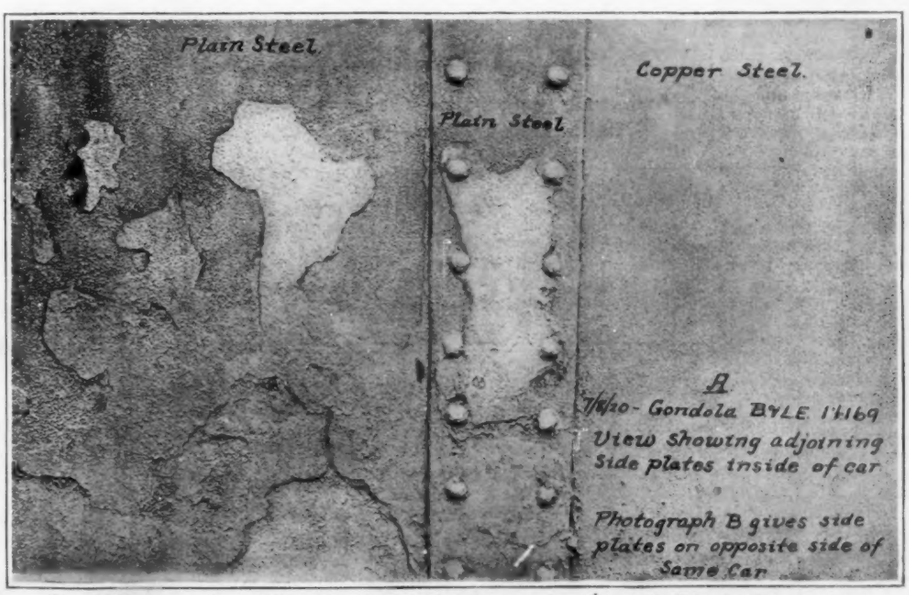
These cars went into service in 1914. Considerable trouble has been experienced in locating them for inspection. The first cars inspected after two years' service showed that the paint on the outside of cars adhered much better on the copper-bearing steel than on the plain steel. This fact has been borne out by all subsequent inspections, and at the end of six years is very noticeable, as will be seen by comparison of the illustrations showing the plain steel and the copper-bearing steel plates in the same car. As a result of the absence of the protective coating, the plain steel shows considerably more and deeper pitting on the outside of the cars.

On the inside of the car, the copper-bearing steel was freer from adhering oxide or rust and less deeply pitted than the plain steel. The accumulation of rust under the rivet heads showed that the loss in thickness was considerably greater on the plain steel than on the copper-bearing steel.

On the outside of a car where the paint had come off recently, a pronounced difference was noted in the color of the exposed surface. The plain steel was rough to the hand, yellowish brown in color, while the copper-bearing steel was much smoother and of a dark reddish-brown color.

The destruction of the body of a steel car is due to several causes, among which are mechanical abrasion or erosion, and corrosion.

The character of the loads carried governs the destruction by mechanical abrasion, as there will not be as much abrasion with materials like ore, earth or cinders as with hard, heavy materials such as pig iron, steel blooms or billets. Mechanical abrasion also has an effect on the corrosion, tending to increase the corrosion by wearing away the corroded surface and exposing a fresh metallic surface, which rusts more rapidly than a surface protected by dirt and a film of oxide or rust. This explains why it was noted in the first inspections that the gondola cars were showing greater effect from erosion and corrosion than the hopper cars.



The relative corrosion exhibited by plain steel and copper-bearing steel plates in the same car, after six years of service

From the Einstein Contest—III

An Introductory Statement of the Place Occupied by Relativity as a Phase of Human Thought

By "Conception" (Frank E. Law, Montclair, N. J.) and Others

MR. LAW'S essay was early eliminated from consideration for the prize on the ground that it devoted too large a proportion of its space to introductory material. But it was clear from a first reading that as an introduction to the subject it was a performance of extraordinary merit, and one that we should certainly want to publish. We have avoided needless duplication by suppressing his concluding paragraphs, in which Mr. Law catalogs the consequences of Einstein's postulates. At the same time we have interpolated passages from other essays which throw additional light upon his discussion.

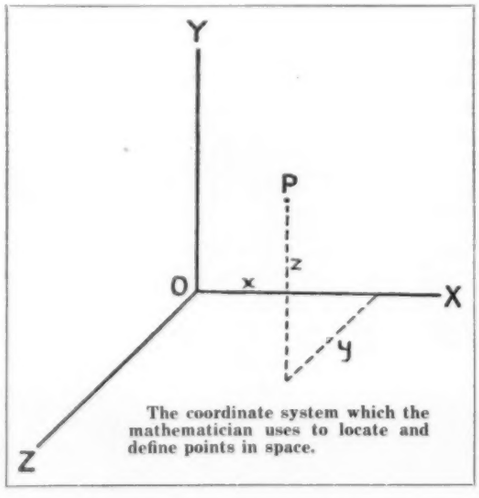
All that part of this text which is not enclosed within brackets is taken from Mr. Law's essay. The bracketed passages identified with an asterisk are supplied by the present commentator. Those abstracted from other essays are identified by the consecutive numbers attached to these essays on receipt in this office; these numbers are interpreted, and due credit assigned to Mr. Law's unintentional co-authors, below. We trust that the brackets, etc., will not unduly distract the eye of the reader, and that this style of composite essay will be found as profitable as it seems to us to be.—THE EINSTEIN EDITOR.

FROM a time beyond the dawn of history, mankind has been seeking to explain the universe. At first the effort did not concern itself further probably than to make a supposition as to what were the causes of the various phenomena presented to the senses. As knowledge increased, first by observation and later by experiment also, the ideas as to these causes passed progressively through three stages—the theological (the causes were thought to be spirits or gods); the metaphysical (the causes were thought in this secondary or intermediate stage to be some inherent, animating, energizing principles); and the scientific (the causes were finally thought of as simply mechanical, chemical, and magneto-electrical attractions and repulsions, qualities or characteristics of matter itself, or of the thing of which matter is itself composed).

With increase of knowledge, and along with the inquiry as to the nature of causes, there arose an inquiry also as to what reality was. What was the essential nature of the stuff of which the universe was made, what was matter, what were things in themselves, what were the noumena (the realities) lying back of the phenomena (the appearances)? Gradually ideas explaining motion, force, and energy were developed. Matter was conceived as consisting of substances, compounds, elements, molecules, atoms, corpuscles, electrons. Contemporaneously with the inquiry as to the nature of matter, motion, force and energy, inquiry was made as to the nature of man, the workings of his mind, the nature of thought, the relation of his concepts (ideas) to his perceptions (knowledge gained through the senses) and the relations of both to the noumena (realities).

[The general direction taken by this inquiry has been that of a conflict between two schools of thought which we may characterize as those of absolutism and of relativism.]* [The ancient Greek philosophers believed that they could tap a source of knowledge pure and absolute by sitting down in a chair and reasoning about the nature of time and space, and the mechanism of the physical world.][221] [Under this absolutist method a single observer is competent to examine a single phenomenon, and to write down the absolute law of nature by referring the results to his innate ideas of absolute qualities and states. The root of the word absolute signifies "taking away," and in its philosophical sense the word implies the ability of the mind to subtract away the properties or qualities from things, and to consider these abstract qualities detached from the things; for example, to take away the coldness from ice, and to consider pure or abstract coldness apart from anything that is cold; or to take away motion from a moving body, and to consider pure action apart from anything that moves. This assumed power is based upon the Socratic theory of innate ideas. According to this theory the mind is endowed by nature with the absolute ideas of hardness, coldness, roundness, equality, motion, and all other absolute qualities and states, and so does not have to learn them. Thus a Socratic philosopher could discuss pure or absolute being, absolute space and absolute time.][221]

[The modern scientist has attained a very much more business-like point of view. To him a law is fundamentally nothing but a short-hand way of expressing the results of a large number of experiments in a single statement. And it is important to remember that this mere shortening of the description of a lot of diverse occurrences is by no means any real *explanation* of how and why they happened. In other words, the aim of science is not ultimately to *explain* but only to discover the relations that hold good among physical quantities and to embody all these relations in as few and as simple physical laws as possible.][221] [This is inherently the method of relativism.]* [Under it a set of phenomena is observed. There are two or many observers, and they write down their several findings. These are reviewed by a final observer or judge, who strains out the bias due to the different viewpoints of the original observers. He then writes down, not any absolute law of nature governing the observed phenomena, but a law as general as possible expressing their interrelations.][121] [And through this procedure modern science and philosophy reveal with increasing emphasis that we superimpose our human qualities on external nature to such an extent that it has been seriously asked whether the external world has any real or "absolute" existence outside our minds. Many of us have sought comfort in the thought that we possess geometrical axioms and mechanical laws as untainted by human sense-perceptions as pure mathematics. Intellects on other worlds should find them as immutable as we.][106] [This conclusion is challenged when we carry relativity to its logical conclusions as Einstein has done.]*



The coordinate system which the mathematician uses to locate and define points in space.

From all this inquiry and criticism, which have gone on for centuries, has emerged the following present-day attitude of mind toward the sum total of our knowledge. The conceptual universe in our minds in some mysterious way parallels the real universe, but is totally unlike it. Our conceptions (ideas) of matter, molecules, atoms, corpuscles, electrons, the ether, motion, force, energy, space, and time stand in the same or similar relation to reality as the x's and y's of the mathematician do to the entities of his problem. Matter, molecules, atoms, corpuscles, electrons, the ether motion, force, energy, space, and time do not exist actually and really as we conceive them, nor do they have actually and really the qualities and characteristics with which we endow them. The concepts are simply representations of things outside ourselves, which things, while real, have an essential nature not known to us. Matter, molecules, atoms, corpuscles, electrons, the ether, motion, force, energy, space and time are merely devices, symbols, which enable us to reason about reality. They are parts of a conceptual mechanism in our minds which operates, or enables our minds to operate, in the same sequence of events as the sequence of phenomena in the external universe, so that when we perceive by our senses a group of phenomena in the external universe, we can reason out what result will flow from the interaction of the realities involved, and thus predict what the situation will be at a given stage in the sequence.

But while our conceptual universe has thus a mechanical aspect, we do not regard the real universe as mechanical in its nature. [This may be illustrated by a little story. Entering his friend's house, a gentleman is seized unawares from behind. He turns his head but sees nothing. His hat and coat are removed and deposited in their proper places by some invisible agent, seats and tables and refreshments appear in due time where they are required, all without any apparent cause. The visitor shivers with horror and asks his host for an explanation. He is then told that the ideas "order" and "regularity" are at work, and that it is they who acquit themselves so well of their tasks. These ideas cannot be seen nor felt nor seized nor weighed; they reveal their existence only by their thoughtful care for the welfare of mankind. I think the guest, coming home, will relate that his friend's house is haunted. The ghosts may be kind, benevolent, even useful; yet ghosts they are. Now in Newtonian mechanics, absolute space and absolute time and force and inertia and all the other apparatus, altogether imperceptible, appearing only at the proper time to make possible a proper building up of the theory, play the same mysterious part as the ideas "order" and "regularity" in my story. Classical mechanics is haunted.][116]

[As a matter of fact, we realize this and do not allow ourselves to be imposed upon with regard to the true nature of these agencies.]* We use a mechanistic terminology and a mechanistic mode of reasoning only because we have found by experience that they facilitate our reasoning. They are the tools which we find produce results. They are adapted to our minds, but perhaps it would be better to say that our minds are so constructed as to render our conceptual universe necessarily mechanical in its aspect in order that our minds may reason at all. Two things antithetic are involved—subject (our perceiving mind which builds up concepts) and object (the external reality); and having neither complete nor absolute knowledge of either, we cannot affirm which is more truly to be said to be mechanistic in its nature, though we may suspect that really neither is. We no longer think of cause and effect as dictated by inherent necessity, we simply regard them as sequences in the routine of our sense-impressions of phenomena. In a word, we have at length grasped the idea that our notions of reality, at present at least, whatever they may become ultimately, are not absolute, but simply relative. We see, too, that we do not *explain* the universe, but only *describe* our perceptions of its contents.

The so-called laws of nature are simply

THE identification numbers found in the text mark passages from the essays submitted by the following contestants:

106—J. Elias Fries, Fellow A. I. E. E., Birmingham, Ala.
116—Prof. Dr. J. A. Schouten, Delft, Netherlands.
121—Elwyn F. Burrill, Berkeley, Cal.
141—Dr. M. C. Mott-Smith, Los Angeles, Cal.
216—Professor Andrew H. Patterson, University of North Carolina.
221—Walter van B. Roberts, Princeton University.
263—Professor William Benjamin Smith, Tulane University.
272—R. Bruce Lindsay, New Bedford, Mass.

statements of formulæ which resume or sum up the relationships and sequences of phenomena. Our effort is constantly to find formulæ which will describe the widest possible range of phenomena. As our knowledge increases, that is, as we perceive new phenomena, our laws or formulæ break down, that is, they fail to afford a description in brief terms of all of our perceptions. It is not that the old laws are untrue, but simply that they are not comprehensive enough to include all of our perceptions. The old laws are often particular or limiting instances of the new laws.

It is not strange that, confronted with the vast and bewildering complexity of the universe and the difficulty of keeping separate and distinct in our minds our perceptions and conceptions, we should at times and as respects certain things project our conceptions illegitimately into the perceptual universe and mistake them for perceptions. The most notable example perhaps of this projection has occurred in the case of space and time. The concepts of space and time are the most fundamental of all of our concepts. They are the frame in which all else is set. We got to think of them as absolute, as independent of each other and of all other things, and as always existing and continuing to exist whether or not we or anything else existed—space as a three-dimensional, uniform continuum, having the same properties in all directions; time as a one-dimensional, irreversible continuum, flowing in one direction. It is difficult to get back to the idea that space and time so described and defined are concepts merely, for the idea of their absolute existence is ingrained in us as the result probably of long ancestral experience.

The space of Galileo and Newton was conceived of as empty, except in so far as certain parts of it were occupied by matter. Positions of bodies in this space were in general determined by reference to a system of three mutually perpendicular planes. [The mathematician tells us very clearly how we may do this. We pick out any point whatever in space and call it O. We then draw or conceive to be drawn through this point three mutually perpendicular lines called coordinate axes, which we may designate OX, OY and OZ, respectively. Finally, we consider the three planes also mutually perpendicular like the two walls and the floor of a room that meet in one common corner, which are formed by the lines OX and OY, OY and OZ, and OZ and OX, respectively. These three planes are called coordinate planes. And then any other point P in space can be represented with respect to O by its perpendicular distances from each of the three coordinate planes—the distances x, y, z in the figure. These quantities are called the coordinates of the point.][272] We find it possible so to choose our coordinate system that the great majority of the stars have, on the whole no motion with respect to it.

[But it is clear that this empty space, in spite of the coordinate system which we have set up in it, is relative.]* [This is not a difficult idea to grasp, and has been accepted in its rudimentary form for many years. The astronomer tells us that the particular spot of earth on which we happen to be standing at this moment and relatively to which we are describing our bodily movements, is being hurled through space relatively to the sun at the rate of approximately 18.5 miles per second. The indication is that our sun is also moving relatively to the other stars; and for all we know these may be moving too,][272] [carrying with them any coordinate system which we may succeed in so adjusting that with respect to them it appears to be fixed. How shall we tell? How shall we attach to one coordinate system in empty space a unique position of preference over others?]* [The thought of such an absolutely fixed point in space as the O of such a system must be, becomes too much for the human brain to act sanely upon, and we fall back on relative space.][272]

This space, and time, have always been conceived as independent of each other. [For the concept of time has ever been one of the most absolute of all the categories. It is true that there is much of the mysterious about time, and philosophers have spent much effort trying to clear up the mystery—with unsatisfactory results. However, to most persons it has seemed possible to adopt an arbitrary measure or unit of duration and to say that this is absolute, independent of the state of the body or bodies on which it is used for practical purpose. In other words, according to this view, time is not affected by conditions or motions in space. At first thought this seems to be a very reasonable hypothesis.][272] [But it is one which we are now obliged to question—and, if we are to accept Einstein's theories, actually to deny.

Before we come to this necessity, however, we must see how]* certain discoveries regarding light and the concepts formed to describe our perceptions of light called for a modification of the empty space of Galileo and Newton. Space under the wave theory of light had to contain something to carry the waves; so it was conceived as filled with a medium which was called the ether. This was conceived to be stationary and at rest and unaffected in any way by the motion of matter through it. Space and time were still independent of each other. This stationary and immovable ether rendered possible the idea of absolute motion, for planes of reference should possess absolute position in it.

An experiment by Michelson and Morley introduced a great difficulty into this concept of the ether space. The experiment was devised to determine the motion of the earth with respect to the ether. Its procedure was to compare the time occupied by rays of light in moving forward along the path of the earth in its orbit, in moving backward along this path, and in moving perpendicular thereto—the distance covered being the same in each case. Obviously these times, if the ether were stationary, would differ: for in the first case the source is overtaking the light, in the second it is moving away from the light, while in the third the velocity of the earth is not a factor one way or the other. But it was found that there was no difference whatever in the time under the three conditions.

[It seemed then that the ether of space must move along with the bodies on which the measurements were made. But from our theories of light and electromagnetism, as will be made clear in more detail in a later essay, if there is any ether at all, it must be at rest relatively to all possible motion.][272] The discovery of the new phenomena consequently entailed a modification in the concept of the ether space heretofore held. New concepts had to be formed which would embrace the new perceptions as well as the old ones, and give a logical and consistent account of all the phenomena.

[The contradiction involved is a very puzzling one, and it gave physicists no end of trouble. However Lorentz and Fitzgerald finally put forward an ingenious explanation, to the effect that the actual motion of the earth through the ether is balanced, as far as the ability of our measuring instruments is concerned,

(*Continued on page 196*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Great Divide

To the Editor of the SCIENTIFIC AMERICAN:

As one of the goodly company who submitted essays in the Einstein Competition, may I through you offer my congratulations to the successful essayist, Mr. Bolton.

Perhaps many others would like to join in an expression of this kind. "Many run but only one can carry the palm," says the old Roman adage; and since it happens that the palm goes not to one of our own but to a runner from a foreign land, it is our privilege to more heartily recognize his victory.

I have read the winning essay carefully, and while without knowledge of the merits of other essays, can readily concede that for directness, clear cut expression and firm grasp of subject, the essay is a fine piece of work. Without undue elaboration, but with enough detail, with orderly and logical sequence, he has set forth the case. It suggests the carefully prepared brief of a mind trained in the law.

Mr. Bolton has done what mathematicians often fail to accomplish, namely, express the reasoning back of mathematical processes, without recourse to symbols. This is a gain, for often the symbol is regarded as the significant whole instead of a restricted part. So it happens that an equation may give results not found to hold in fact. Like some surgical operations, which are regarded as successful from the surgeon's viewpoint, but from which the patient may not ultimately recover, so some mathematical operations are chiefly successful from the operator's point of view; and are not helpful to the investigator. Perhaps this is why Professor Eddington recently said: "A mathematician is never so happy as when he does not know what he is talking about!? Let us modify this to read "Some of us are frequently made quite unhappy because we do not know what the mathematician is talking about." And some of us who have for a lifetime been compelled to watch equations, stretched, torn and tortured, yes, put upon the rack, and made to confess what really is far from the truth—well, we favor the formation of a Society for the Prevention of Cruelty to Equations.

The successful essayist says that some things cannot be visualized. Perhaps not as yet. He says, too, it is not necessary. "It is merely one of those irrelevancies to which those unaccustomed to think in symbols are liable." But when the time does come to use the symbol, let us carefully scrutinize the symbolization. There can be no doubt that the essayist has set us a good example, in not overloading his discussion with formulæ.

ALEXANDER MCADIE.

Harvard University.

To the Editor of the SCIENTIFIC AMERICAN:

Since there were three hundred contestants for the Einstein essay prize, and since there was but one winner of it, it seems mathematically probable that 298 disgruntled competitors have already threatened to have you hung. As we have no designs on your life or property we should object to being classed with such undue accelerators of the law. But as defenders of more politely expressed indignation may we still be allowed to subscribe ourselves as The Two Hundred and Ninety Ninth?

Without access to the various essays which were rejected by the judges it is, of course, impossible to term their judgment wrong. But is it really true that all the other essays were as bad as that of Mr. Bolton? Is it conceivable—as they must have been—that they were even worse? Your intention, frequently set forth, was to give Mr. Eugene Higgins' generous prize to the author of that essay which should most clearly and simply announce the Einstein theories of relativity. Apparently you found an essay which, to you, seemed to satisfy those admirable conditions. For the work of Mr. Bolton was not only finally selected over the heads of many other essays: when you printed it you expressed a disbelief that "it would be possible to make any material improvement upon Mr. Bolton's selection of the ground to be covered in an essay of this character." More, you said that "everybody will of course agree that he says admirably what he has to say."

We shall take up little of your valuable space. We shall confine ourselves to the question, What do you mean by "an essay of this character"? for the answer to that question is the whole root of our reason for disagreeing flatly with your belief that he says admirably what he has to say. We maintain that he says it abominably.

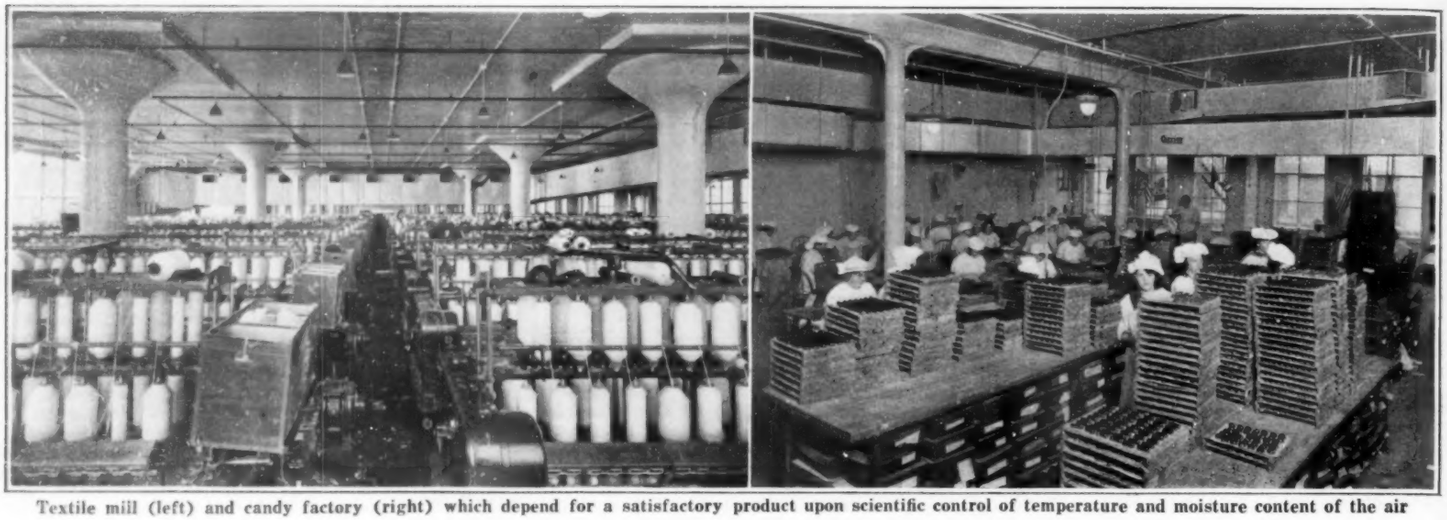
Technicalities are ruled out. The manner here is the whole matter. The principles of relativity are simply to be elucidated, made clear in easy English for the average non-technical reader to see and understand. And what do we find? Blithe references to "coordinates," "continuums," "graphs," "frames of reference," "Euclidean propositions" and the like; a brief exposition of the theories of Karl Gauss in the statement that "all Gaussian systems are equivalent for the statement of general physical laws"; and, finally, as a general introduction to a mass of badly phrased facts—as a topic sentence in which one at least expects a little beguiling optical ease—the world is met with the following masterpiece to crack its head and hopes against: "The reader is probably acquainted with the method of specifying positions of points in a plane by their distances from two mutually perpendicular lines, or if the points are in space by their distances from three mutually perpendicular planes like adjacent sides of a flat-sided box."

As a patent-expert Mr. Bolton undoubtedly knows his business, as editors you undoubtedly know yours, and perhaps we will be told to mind our own. But we cannot refrain from entering a protest against what we consider a gross miscarriage of common sense under the terms and articles of the contest.

We entered that contest. We lost the prize. And we are quite satisfied that we lost it fairly. We nevertheless insist that even the readers of your magazine are probably not widely acquainted with the method of specifying positions of points in a plane by their distances from two perpendicular lines, especially when a simple geometric proposition is couched in such unnecessarily bewildering language. And so we say that if the rest of the essays were as bad as "Zodiaque's" it would have been fairer to the world for the judges to have withheld the prize entirely, and to have announced regretfully that the competition had resulted in a stalemate of stupidity. As a Parthian shot, may we express regret that Mr. Bolton was more successful in practising one of the Gaussian theories than he was in elucidating any of them? We mean the Gaussian Theory of Least Constraint.

MALCOLM K. PARKHURST,
WINTHROP PARKHURST.

New York City.



Textile mill (left) and candy factory (right) which depend for a satisfactory product upon scientific control of temperature and moisture content of the air

Making Weather to Order

The Indoor Meteorology That Makes All the Difference Between Industrial Success and Failure

By Harry A. Mount

THE effect of weather on all human activities is so tremendous that men have been trying, since time immemorable, to control it in some degree. The fellow who tried (and is still trying) to make the rain pour or to cease pouring at his command, found that he had a rather large order on his hands, and our great food crops are still at the mercy of the elements. But not so with the manufacturer, to whom weather is just as important as it is to the farmer. He has found a solution of his weather problem.

Most manufacturing processes are carried on within the protection of four walls and a roof. Why not condition the air within that enclosure to suit the need, regardless of outside conditions? And conditioning here means controlling not only the temperature of the air, but also its purity (cleanliness), and its humidity or moisture content. This can be and is being successfully done. The fact is, or ought to be, of great importance to nearly every industry in the land; for weather "manufactured to order" assists in solving a myriad of problems which at first seem to have little or no relation to it.

For instance, in the textile industries it is possible to speed up machines and workers alike and at the same time to lessen the hardships imposed on both, simply by the use of manufactured atmosphere. A textile fiber is like a sponge in its affinity for water, and it takes all it can from the surrounding air. If it becomes too moist it loses strength and breaks easily. If it is too dry it becomes brittle and snaps during the spinning and weaving. If the humidity of the air is carefully controlled the machinery can be speeded up with less breakage of yarns. In most textile mills hundreds of machines and workers are crowded into a single room. The heat from the machines, even in winter, becomes almost unbearable and investigators have blamed much labor trouble on this condition. In speeding up the machines by air conditioning the work-rooms are kept in a comfortable state and it is found in actual practise that the workers speed up along with the machines and are more contented.

It has come to be recognized that the most important factor in conditioning air, whether it be for human comfort or to aid in a manufacturing process, is to control the humidity. Failure of the early experimenters to do this economically has delayed for so long this apparently simple development.

One of the early fallacies was attempting to raise the humidity of the air by atomizing water directly into the atmosphere. But a lot of heat is required to vaporize water. One engineer has shown that if the heat required to vaporize one pound of water were turned into mechanical energy it would lift a 150-pound man from sea level to the top of a mountain five thousand feet high. This method, obviously, is uncertain, extremely difficult to control, non-uniform in result, and dangerous to fine machinery because free water is often deposited.

The modern engineer takes advantage of the natural tendency of air to absorb all the moisture it can hold. He simply supplies the moisture in a form which the air can most readily absorb—as a fine spray. Humidity, it ought to be explained, is a relative term. The amount of moisture which the air can hold depends on its temperature and air which is "dry" at one temperature may be "wet" at another, although the actual moisture content has not changed. Thus in winter if we take air from the outside of our home, supposing it is saturated, that is, it contains all the water it will hold at that temperature, and heat it to 70 degrees it would then contain only one-sixteenth of the moisture it could hold at its new temperature. Thus without changing the actual moisture content, we would have turned wet air into very dry air and it begins absorbing moisture from every possible source, even from the furniture and woodwork. For this reason humidity, by which is commonly meant "relative humidity," is expressed in percentages. Thus air with a humidity of 50 per cent holds but half as much water as it could at its given temperature, if it were saturated.

It will be seen that to reduce the relative humidity of the air in winter one has simply to heat it. In summer refrigerating apparatus is provided to cool the water spray through which the air is drawn. As the air enters the thick cloud of spray it is chilled and part of the moisture condenses and is carried away by the falling spray. By controlling the temperature of the spray with respect to the temperature of the outside air the humidity can be very closely controlled. For adding humidity to the air the reverse process is carried out. When relatively dry air is drawn through a warm spray it picks up moisture.

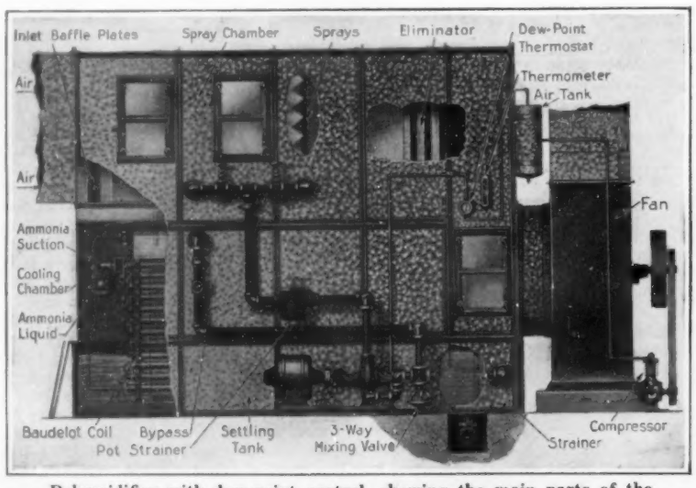
One might imagine from the foregoing that while an air conditioning machine is very simple, it would require constant attention from a trained engineer to maintain a given air condition within a building. As a matter of fact the machine itself is more complicated and has in addition to the spraying apparatus a series of inlet baffle plates to distribute the air passing through the machine and a set of eliminator plates through which the air passes after leaving the spray, which collect all excess moisture that might otherwise be carried as fine spray by the mere velocity of the air. There is also heating or refrigerating machinery, according to the effect desired, and a carefully designed duct system for distributing the air. As for the operating engineer, his work is done by two or three strategically placed thermostats or hydrostats, which maintain any given air condition day and night for an indefinite time, without attention.

In the design of a duct system the engineer is put to the test, for no matter how well the conditioning machine does its work, the air will be useless unless properly distributed. Each installation is a separate problem and must be calculated to a nicety, taking into consideration the size and shape of the air ducts, their placing, size of the outlets and the velocity of the air as it leaves them, avoidance of draughts, etc.

Another principle of nature is taken advantage of where cool and moist air is needed in summer: this is the cooling effect of evaporation. When partially saturated air is passed through water-vapor it becomes saturated, and in doing so gives up some of its heat passing into the room perceptibly cooler. The drier the warm air outside the greater is the cooling effect. Thus in a textile mill in Boston where this plan is utilized a cooling effect of from 20 to 25 degrees below the outside temperature is often attained. Another installation, nearly identical, delivers the inside air from 25 to 30 degrees cooler than that outside.

Of course the textile mill is but one example of hundreds of industries which are making profitable use of manufactured weather. One of the reasons the bread you buy from a large baking house is uniformly good is because it is raised in rooms where the weather is always right for bread making. The old time baker had to guess when his dough was

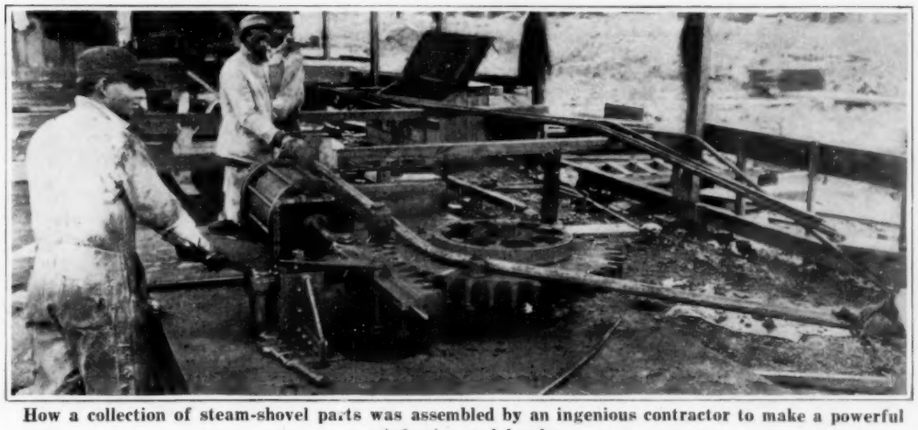
(*Continued on page 198*)



Dehumidifier with dew-point control, showing the main parts of the controlling mechanism

A Bar-Bending Machine from a Discarded Steam Shovel

ONE of the largest engineering problems being solved by this country at present is the Industrial Canal and Inner Harbor, being built at New Orleans. The country through which the canal will pass is beneath the sea level, and a creek, or drainage canal, crosses the line of the Industrial Canal. Concrete is being laid upon a foundation made of thousands of wooden piles and steel reinforcing. The drainage canal is made to pass through a siphon, directly under the ship canal, so as to prevent any change in the level of the latter. Huge locks, which engineers on the work claim are more difficult to construct than those of the Panama, are being built above this same mud and quicksand foundation. The details of this work were recently covered in these columns.



How a collection of steam-shovel parts was assembled by an ingenious contractor to make a powerful reinforcing rod bender

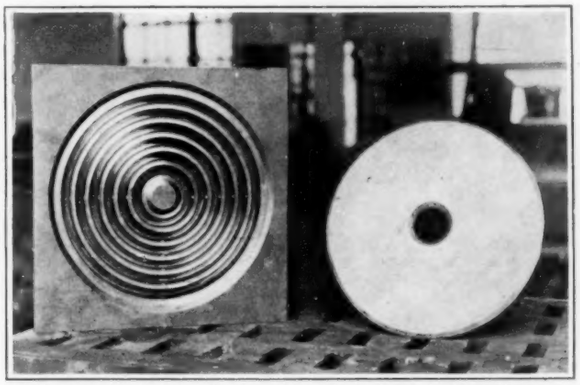
Now for the reinforcing of the concrete used in these locks, it is necessary to change the form in order to meet various circumstances; and it is for the purpose of bending the iron bars into any desired shape that the machine, shown in the accompanying illustration, is used. It will be noted that the parts for this machine could be readily located on any large engineering project. It consists of a large table, made of heavy wooden sections, securely bolted together and having the upper surface covered by a piece of sheet steel. The bar to be bent is placed over the guide rails, which have been built of heavy pipe and are placed at both ends of the table. The particular part to be bent is placed between the collar and a dog, both of which are made part of the large, geared revolving member. The action is produced by an air cylinder which drives a rack, geared to the rotary or bending member. The air pressure is regulated by a valve and the bars may therefore be bent at any desired speed. Bends of any description may be obtained by simply changing the size of the collar and the location of the dogs.

It is interesting to note that the parts for this bending machine have been recruited from the remains of a discarded steam shovel, and that the work they do is not at all in line with that for which they were built. The size of the rod which is being bent is 1 3/4 inches in diameter. The bending is done while the bars are cold—and done with the utmost ease.

Welding Where Casting Fails

THE first and last stages of an interesting and unusual application of welding are illustrated in the accompanying photographs. This work was performed for a firm manufacturing hydraulic machinery, and was intended for filling a contract calling for steam-heated brass platens for the curing of phonograph records.

After trying a number of methods of making the necessary steam passages in castings by the use of cores, it became evident that satisfactory castings could not be produced by this method. They could not be made impervious to the steam. Accordingly, a new line of procedure was undertaken, to wit: In a solid rolled-brass plate (1½ inches thick by 14 inches square) concentric grooves were turned to a depth sufficient to give the necessary steam capacity. The whole working face of the plate (12 inches diameter) was also cut away to a depth of ⅜ inch except for a central boss, to accommodate a cover plate which was to be welded to the central boss and to the outer circumference of the undercut. This central boss and the outer circumference of the undercut were champfered away in the manner usual for preparing an edge to edge weld. The circular cover was then prepared with the edges beveled in the same manner, leaving the usual trough for welding. A specially prepared clamping jig was then affixed to prevent warping, due to contractional strains, and the entire job was preheated, the welding done in the usual way, and the plates allowed to cool slowly in the fire. As a result of the annealing all contractional strains were satisfactorily eliminated.



First and last stages in preparing steam-heated brass platens by the welding process

The final operation was performed by facing off the plate in a lathe, and the work was so well done that it was barely possible to discover the joints. The plates have given complete satisfaction in service.

Casting a 60,000 H. P. Hydraulic Turbine

SOME remarkable casting work has been done in connection with the building of six hydraulic turbines, each of not less than 60,000 horsepower capacity, for the Hydroelectric Power Commission of Ontario. These units will be installed at Niagara Falls.

The spiral casing of the 60,000-horsepower hydraulic turbine is a gigantic piece of apparatus. The inlet diameter is 10 feet, and the distance across the casing at the widest part is about 38 feet. From center to the extreme edge of the inlet flange is 22 feet. The casing is made in nine sections, and in order to insure the accurate casting of these sections a skeleton pattern for the entire casing was first built as shown in our cover illustration, and then separated into nine sections.

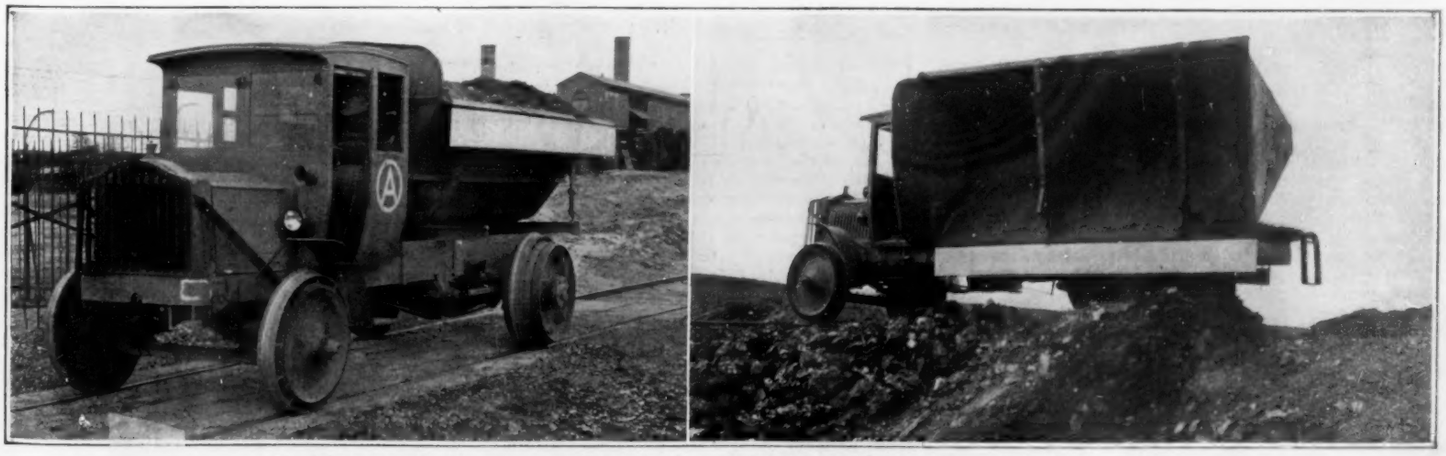
In order to secure castings that would safely withstand the enormous hydraulic pressure, the various sections were cast on end so that all impurities would float into the risers, leaving the metal absolutely sound. Once completed, the castings were bolted together with the speed ring, or member which fits inside the spiral, and subjected to a severe water pressure test far in excess of the normal working pressure.

Soldering Zinc

IN soldering zinc, the surfaces should be carefully cleaned as in the case of any metal and the ordinary acid soldering flux used in soldering galvanized iron may be used. The ordinary half and half solder is satisfactory and a moderately hot iron is best. The solder should be applied while the surfaces are still moist with the flux and the iron should not become red hot or kept in contact with the zinc longer than necessary to give a good joint. One quick pass is usually enough and if the iron is too hot the metal may be melted and is almost sure to be weakened.

Expediting Handling of Foundry Refuse

A LARGE foundy located at Albion, Mich., has recently introduced a motor truck and a special railway for handling its refuse, and the results are said to be highly satisfactory. The motor truck in this instance is of 8-ton capacity, equipped with flanged wheels and a special dump body, as shown in the two accompanying illustrations. The truck operates on a short length of track extending from the foundry to the dump heap. The foundry officials state that the installation of this truck and railway has taken the place of three teams and seven men in handling refuse, to say nothing of taking care of it more expeditiously.



An eight-ton truck doing service in a foundry by carrying the refuse from the plant to the dump heap

Air Plus Oil Equals More Oil

How Compressed Air Takes the Place of Natural Gas in Stimulating the Flow of Old Wells

By Robert G. Skerrett

THE possible exhaustion of our pools of petroleum is no longer a matter merely for the speculation of technicists—it touches all of us sooner or later, no matter whether we live in the rural districts or in the densely populated cities. Aside from petroleum's part in providing motive energy, something that coal does on a much grander scale, the wheels of industry would become sluggish and even stop if they lacked a sufficiency of lubricants. It is from petroleum that we get the greatest measure of our lubricating oil; and a plenty of this we must have whether the primary source of power be water, coal or oil.

As the situation stands today in the domestic oil industry, we are virtually living from hand to mouth, and the demand is becoming harder to meet despite everything that is done to augment production. "In September of 1920, as in August, the daily output of the United States oil wells was slightly over 1¼ million barrels, but the daily consumption rose to 1⅝ million barrels. This daily deficit of ⅜ of a million barrels was met by imports from Mexico. To this extent, then, we are already dependent upon a foreign supply of oil."

That we must rely less upon petroleum for motive purposes and more upon the burning of coal and the utilization of our falling waters is inevitable. The same eminent authority just quoted has made this clear by citing the utmost possibilities of our natural power resources. For instance, if the entire load of our present power requirements were carried by steam plants using coal, our mines would be able to tide us along for a period of 57,000 years. Whereas if fuel oil were substituted for coal for the same service our billions of barrels of reserves under ground would last for only 9¼ years.

Again we learn that if no more oil wells were drilled for a year our production would fall off from 25 to 35 per cent. Therefore, each twelvemonth it is necessary to drill new wells and to find fresh fields of supply, and just where these may lie is not known at any time with certainty. Only by ceaseless and expensive exploration is it possible to prevent a day of serious shortage. With 40 per cent of our original store of petroleum exhausted, the near future bristles with difficulties. Yet the outlook is really better than at first blush it seems, thanks to work that is being done in various direction, of which the general public knows little.

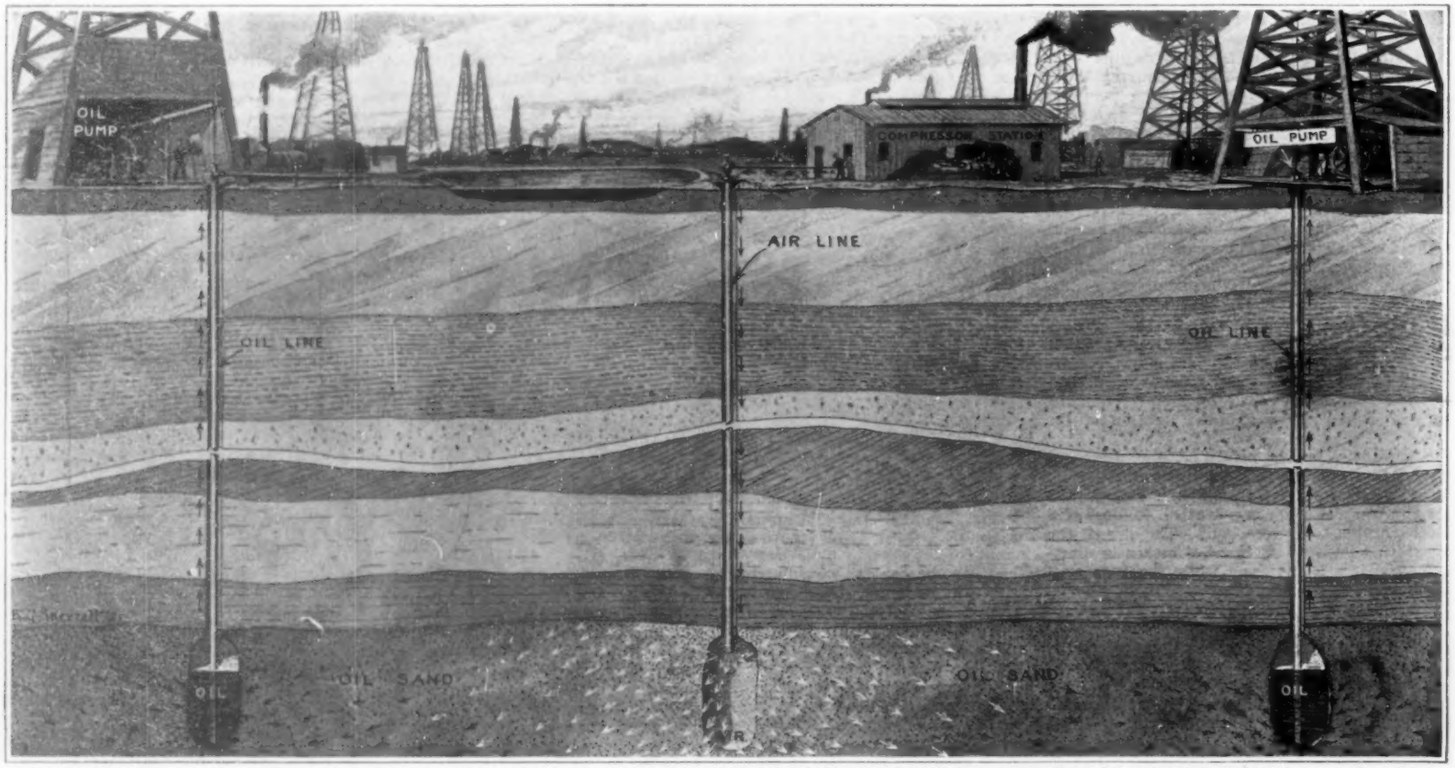
Time and again we have been told that the prevailing methods of extraction are quite incapable of recovering from the oil-bearing sands more than 20 per cent of the petroleum hidden away in the subterranean pools. Accordingly, man's ingenuity has been spurred on to devise ways by which a greater measure of this natural bounty can be obtained; and in this quest the scientist and the engineer have collaborated with heartening success. As a matter of fact many old and abandoned properties have been given a new lease of life, and amazing quantities of oil have been withdrawn from sands apparently drained or rapidly nearing the end of their yield.

Broadly stated, there are many reasons for believing that the capacities of the oil sands in the different fields in this country are anywhere from five to ten times greater than the quantities of oil usually realized from them. The failure to obtain a larger measure of the petroleum is principally due to the dissipation of the natural gas following the driving of a well. The velocity with which this gas is known to escape is a fair index of the pressure under which it has been stored beneath the overlying rock which for ages has held the gas confined. This pressure not infrequently reaches a thousand pounds and more a square inch; and the oil is charged with this gas much after the fashion of the contents of a bottle of soda water.

When the oil prospector drives his well he taps a virtually sealed reservoir. Instantly the pent-up petroleum is offered an avenue of escape, and the expanding gas serves to force the oil surfaceward. This explains the action which takes place at spouters; and so long as the oil flows naturally the movement is due to the impulse imparted by the gas. Of course, the oil may still come above ground through gravitation if there are hydrostatic conditions that provide a sufficient head. But, normally, pumping is relied upon to lift the deep-seated oil after the gas pressure drops to the point where it will no longer help.

It seems perfectly logical, under the circumstances, that the fertile-minded should suggest a partial replacement, at least, of the original gas pressure, achieving this artificially by using air forced down by suitable compressors. Despite the skepticism that has belittled the value of this procedure, the Federal authorities have latterly announced that on many old properties in the eastern fields this application of compressed air has increased the recovery of petroleum variously from 50 to 100 per cent.

Ten years ago, out in Ohio, I. L. Dunn, profiting by an earlier experiment, decided to see if he could not boost up the output of property on which the wells had dropped to an average of 7 gallons of oil daily. Selecting an abandoned well for his test, he forced into it for about a week 150,000 cubic feet of free air every twenty-four hours at a pressure of 40 pounds. At the end of that time the production of the surrounding wells was raised something like 70 per cent. Here the



Compressed air is pumped in to make good the diminished natural-gas pressure. The air is pumped down a shaft that is used for this purpose alone, being definitely abandoned as an oil producer. It serves to force the oil away from the zone of air pressure about the foot of the air shaft, and toward the intakes of the oil pumps, the overlying rock formation acting as an imprisoning barrier above the air

Diagrammatic representation of the Marietta process for restoring the flow of exhausted or nearly exhausted oil-wells

Subsequently, within an interval of five years, the process was resorted to on fully 90 properties, and four-fifths of these efforts amply justified the outlay. The wells involved numbered around 4,000; and substantially all of them lay in the fields of southeastern Ohio and the northwestern section of West Virginia. In the interval that has followed, the adoption of the method has gradually widened, and certain improvements have been developed as the result of riper experience. Further, it is now realized that commercial success in any region is contingent upon the nature of the oil sands, the associated geological conditions, and the manner and extent to which the field has already been worked.

The method commonly pursued in the so-called Marietta process—thus known because it was first tried out near the town of that name in Ohio—consists fundamentally in forcing air through selected wells into oil-bearing sand was of a coarse and pebbly character; in short was such as to facilitate the flow of the petroleum under the impulse of the compressed air.

(*Continued on page 199*)

Trumpeter swans of the recently discovered colony in British Columbia

The Papaya, or Tree Melon

By Dr. Wm. A. Murrill, New York Botanical Garden

THIS is one of the most delicious of all tropical fruits and the tree on which it grows is noted for its beauty and productiveness. In the Hawaiian Islands, the papaya ranks next to the banana in popularity, while in Mexico, Cuba, and Jamaica I have found it to be a common and much esteemed article of diet. From its original home in Central America, the tree has been carried to all parts of the tropics, being able to pass the winter in the open as far north as Jacksonville, Florida, and the southern part of California.

The common name, papaya, is a corruption of the Carib word *ababai*, while the scientific name, *Carica Papaya*, is derived from the same source and from a supposed resemblance to the fruit of figs. Papaya is preferable to papaw, because the latter term is also applied to a small tree growing along streams in the southeastern United States, bearing small yellow, oblong fruits that taste somewhat like an overripe muskmelon.

The papaya tree is small and shapely, resembling a palm, having a single slender trunk surmounted by a cluster of large leaves, while the conspicuous melon-like fruits cling closely to the stem below. It grows to a height of from ten to thirty feet in cultivation, but in the wild state may reach sixty or a hundred feet. The wood is of no value whatever, being so soft and spongy that it can be cut like a potato, and in young trees there is little more than a large central cavity surrounded by pith.

The leaves are about two feet across, deeply lobed, with long stalks and fall off early, leaving large scars on the trunk. The flowers are of two kinds, male and female, usually borne on different trees. The former are funnel-shaped, one inch long, five-lobed, white or yellow, and borne in drooping clusters a yard in length. The female flowers, which give rise to the fruit, are considerably larger, usually yellow, or rarely purple, and are situated in the axils of the upper leaves.

The fruit is much like a melon, being oblong or rounded, yellow or orange when ripe, three to twenty inches long, and weighing at times as much as twenty pounds. On being cut open, a large cavity appears containing wrinkled, blackish seeds the size of small peas. The orange-yellow flesh, one to two inches thick, is sweet and refreshing in the best varieties, but may be insipid in others. I found it agreeable from the first, but some have to acquire a taste for it. There are great differences in the size, shape, and quality of the fruits grown in different regions and under different conditions. Of the numerous varieties in cultivation, the one in which the leaves are more or less violet-colored is very highly esteemed.

The fruit is considered very nutritious and wholesome, either in the fresh state or cooked, provided it is thoroughly ripe. It is commonly used in the tropics for breakfast as we use melons, with the addition of sugar, lemon juice, or salt and pepper, as preferred. It is also served with sugar and whipped cream as a dessert; with lettuce as a salad; or with water, eggs, and milk in the form of a sherbet. Stewed papaya is eaten plain or in pies, custards, and crystallized shapes; while preserves, jellies, and pickles are also made of it. Even the seeds are eaten, being aromatic and pungent like watercress.

The green fruit is often cooked as a vegetable, resembling squash. It is peeled, sliced, mashed in cold water, which is frequently changed to remove the acrid juice, and then cooked quickly in boiling water. The bark is used for ropes and the leaves for soap and for removing stains from clothing. Slices of the ripe fruit make an excellent cosmetic for the face and other parts of the body, removing warts, pimples, and discolorations, and healing boils and sores. All parts of the plant, as well as the fruit, exude a milky juice containing papain, an enzyme which promotes digestion like the pepsin secreted by the glands of the stomach. If meat is rubbed with this juice, or cooked with the fruit, or wrapped in the leaves for several hours, it becomes tender, which is a great aid to digestion in warm countries where flesh must ordinarily be eaten as soon as the animal is killed. It is impossible to estimate how many lives the papaya may have saved in this way, or how many it may have prolonged and gladdened.

Papaya trees must have plenty of space and sunshine. This is why they never form thickets but only clumps, at best. When clearings are made in the tropical for-

(Continued on page 200)

The Trumpeter Swan

By T. M. Fraser

AMONG the water-fowl long considered extinct in nearly all parts of the North American continent, and certainly extinct in many parts where it formerly had its habitat, is *Cygnus buccinator*, the trumpeter swan. This, the largest of the swan kind, and the largest of the water birds known to have existed in North America, was always an easy mark for the sportsman; and although only the young fowl were agreeable to the cultured palate, the Indians slaughtered and ate young and old indiscriminately. The result was that, although at one time extremely plentiful, particularly in Canada, where their breeding range extended from the Rockies to the western shore of Hudson Bay, and from latitude 60 degrees to the Arctic, they were finally practically wiped out like the passenger pigeon and the buffalo. It was with peculiar interest, then, that at the recent annual meeting at Ottawa of the International Association of Fish, Game, and Conservation Commissioners, those present learned that a large colony of trumpeters had been located on a lake in the interior of British Columbia, where they have been breeding.

Observations vary as to the last appearance of these fowl in the United States. As far back as 1884 they were found only in small numbers in California, where they had once been extraordinarily plentiful. There were occasional reports of their appearance in different parts of the United States up to 1893, but they were not confirmed as genuine. The Canadian Government naturalists, the Messrs. Macoun, in their report published in 1909, recorded that several nests of trumpeters had been found by a Canadian Government explorer in the barren grounds on the islands in Franklin Bay, and on the beach there a nest was taken with six eggs. In 1891, a nest was found at Buffalo Lake, Alberta. It was three feet in diameter, composed of sods, grass and rushes, lined with feathers and down.

Up to the 1850's the trumpeter swan was more or less common, and McFarlane, the Canadian naturalist, says that between 1853 and 1877 the Hudson Bay Company in Canada sold 17,671 swan skins, the num-

(Continued on page 200)

From left to right, the views show: male (above) and female (below) flowers of the papaya; a papaya orchard; a grafted tree in fruit; and a fine type of the seedling fruit, reaching ten inches or more in length

The papaya, a little known edible fruit, and how it grows

The Heavens in March, 1921

The American Association of Variable Star Observers and Its Work

By Professor Raymond Smith Dugan, Ph.D.

IN the absence of Dr. Russell, who has gone to England for the conferring of his Royal Society Medal, we present this month his colleague in the Department of Astronomy at Princeton, Dr. Dugan—a most acceptable substitute.—THE EDITOR.

THOSE who read the monthly articles on astronomy will be interested in the purposes and achievements of the American Association of Variable Star Observers.

The peculiar importance of this banding together of amateur astronomers lies in their recognition of the fact that they are well able to carry on as important a line of research as any that is being followed at the observatories of the country, and their assumption of a large part of the responsibility for the continued observation of the long period variable stars.

Interest in a mild form of astronomy is quite widespread. Most people have taken the trouble to learn to recognize a few of the constellations, and accept eagerly an invitation to have a look through a telescope. A good many people have read of and tried to understand the method by which the diameter of Betelgeuse was measured. A few boys buy small telescopes or make telescopes themselves or rig up cameras to photograph the sky. Here and there is a man who has kept his telescope, takes it out in his backyard on an occasional evening for a look at Jupiter, Saturn and a few of the nebulæ and double stars, and sometimes thinks to himself that if things had worked out differently he might have become an astronomer in a big observatory where all the discoveries are made and the big problems of the universe brought nearer to solution; or, if only he had lived a few hundred years ago when the three-inch telescope was a big telescope, he might have had a chance to make some observations of value.

Desiring to benefit such potential observers and inspire many more by suggesting to them a program of serious observation, and at the same time hoping to build up an organization which would gladly take up the observation of the much neglected long period variables, seven enthusiastic observers of variable stars founded the nucleus of the association in 1911. The late Professor Pickering offered to furnish the organization with charts of the regions containing the variables, and Professor H. C. Wilson offered the columns of *Popular Astronomy* for the publication of the observations. Mr. W. T. Alcott offered his services as secretary, writing to those already interested and inducing others to become observers. That he found some remarkably fine observers hidden away, there is little doubt. From a start of seven members, the number has gradually increased to over two hundred. The association has accumulated over 110,000 observations in the past nine years and is following nearly 500 variable stars. Observers have been found in Japan, Siam, India, Italy, Spain, France, England and South America who are willing to join in the work, so that the association is able to keep a watch, when necessary, on the whole sky throughout the whole twenty-four hours.

In 1917, after the Association had proved its worth and felt that it would stay together, it was formally organized and incorporated under the laws of Massachusetts and took its place among the astronomical societies of the world.

The Association has a collection of nearly 500 slides which is available for loan to any of its members. It also has under its control some twenty telescopes which are loaned to deserving members who wish to improve their working conditions. Through the generosity of one of the members the Association is prepared to award a medal to any member who is the first to discover a Nova.

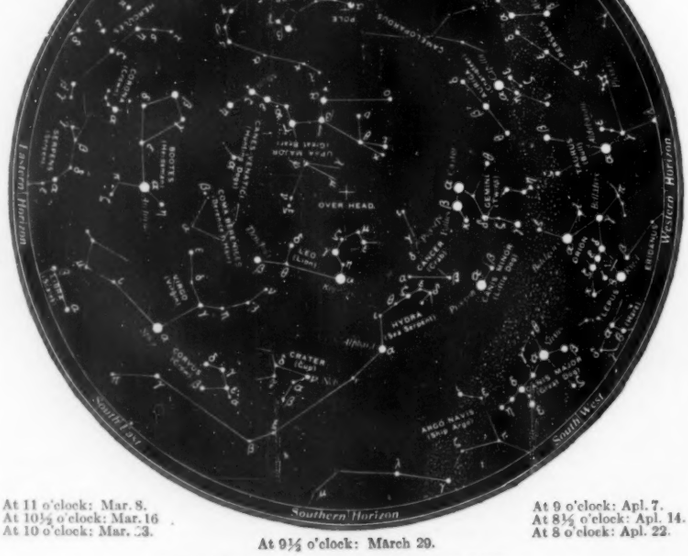
The vocations of the members are certainly varied; clergymen, students, lawyers, farmers, doctors, teachers, reporters and bankers are included in the ranks. Many more observers are needed. There are a great many long period variables known and many more will be discovered. The brightness of many of these variables makes their observation easy with small telescopes, in some cases even with a field glass or with the naked eye. Their slowness of variation makes it possible for the observer to work at his convenience and their great range of variation makes them interesting. The causes of their variation are not known and cannot be known until many more observations have been made. Skill in observation of variable stars is readily acquired by one gifted with patience. The Association also needs many more telescopes and their gift or loan would be much appreciated. That they will be put to good use is assured.

Two Nebulæ with Unparalleled Velocities

Professor Slipher states that recent observations at Lowell Observatory with the nebular spectograph have shown that the nebulæ N. G. C. 584 and N. G. C. 936, both evidently of the spiral family, possess much the highest velocities yet observed for any objects. Exposure of 28 hours and 34 hours, respectively, were required to secure serviceable spectra. The displacements of the spectrum lines are toward the red in both cases and correspond to the exceptional velocities of 1,800 and 1,300 km/sec., respectively. The motion is in each case away from the sun. The radial velocities of spiral nebulæ heretofore observed average about 400 km/sec. Eleven of the nineteen gaseous nebulæ in the Greater Magellanic Cloud are receding at velocities ranging from 237 to 287 km/sec. and about 150 km/sec. is the average radial velocity of the Globular Clusters. The velocity of the sun is about 18 km/sec.

The Heavens

The bright winter constellations and the Milky Way, which lies roughly parallel to them, have swung around, pivoting at the north, and have taken up a position nearly parallel to the western horizon, from Cassiopeia nearly in the north, through Perseus in the northwest, Taurus in the west, and Orion a little to the south of west, to Canis Major in the southwest. Leo, looking like a sickle, is high up on the meridian. The Great Bear is about the same distance to the north of the zenith with the dipper upside down. Gemini is about half way from the zenith to Orion, and Auriga is to the west of Ursa Major. Procyon can be found with the aid of the knowledge that it forms a fairly good equilateral triangle with Sirius and Betelgeuse. The handle of the dipper points roughly to Corona Borealis in the east. Looking toward the east one sees Spica in the southeast in a region devoid of other bright stars, and Arcturus nearer east and at about the same altitude. Vega is just appearing above the horizon in the northeast. The Autumnal Equinox is about two fifths the way on a line from Spica to Regulus.



At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23.

At 9½ o'clock: March 29.

At 9 o'clock: Apl. 7.
At 8½ o'clock: Apl. 14.
At 8 o'clock: Apl. 22.

NIGHT SKY: MARCH AND APRIL

Sun, Moon and Planets

In latitude N. 40° the sun rises on March 1 and 31 at 6:45 and 5:47 and sets at 5:50 and 6:22, respectively, all times being Local Mean. The corresponding standard time may be found by adding to or subtracting your longitude from the standard meridian, according as you are to the west or east of it. The sun crosses the celestial equator from the south to the north side on March 20 just before midnight eastern standard time, bringing spring with it. The mean sun, whose distance from the meridian is indicated by our clocks—at least the good ones—will then be about 1¾ degrees to the west of the true sun and will not arrive at the Vernal Equinox until the evening of the 22nd.

The moon is new on the 9th and full on the 23rd. The next Sunday, March 27, will be Easter Sunday.

Mercury reaches greatest western elongation on the 29th, but is still low in the east at sunrise.

Venus is an evening star and has started back toward the sun. The phase becomes more and more crescent and the apparent diameter increases from 30″ to 48″. During the early part of the month a large component of the motion of Venus is toward the earth and it moves eastward from Pisces into Aries. As the planet swings in toward inferior conjunction the component of its motion parallel to the earth's motion increases until it is equal to the latter on the 31st, at which time the planet ceases its eastward motion among the stars, and at once starts to "retrograde." On March 16, or at about half the interval from greatest elongation to inferior conjunction, it attains its maximum brilliancy of magnitude —4.3, or about 100 times that of Sirius. The brightness of Venus in the daytime is always surprising to those who see it then. The only difficulty lies in looking in the right direction. She crosses the meridian at about 3 P. M. on the first of March and about 2 P. M. at the end of the month. One should look south and high up—about 20° from the zenith. The crescent moon and Venus less than 6° apart will make a pretty sight on the 12th.

Mars is being gained on slowly by the sun. At the end of the month they are only 1h.35m. apart. Mars is far around its orbit on the other side of the sun and getting fainter.

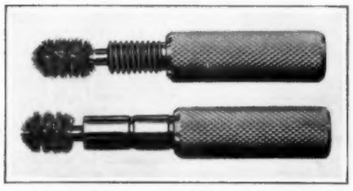
Jupiter retrogrades during the month from about 15° to about 12° east of Regulus, and is at maximum brilliancy. It is in opposition, and therefore nearest the earth on March 4, when it crosses the meridian at midnight. Its apparent diameter is 41″.5 and with a power of 45 it should look as large as does the moon to the naked eye.

Saturn is a few degrees to the east of Jupiter, but nearly three magnitudes fainter, and is moving westward among the stars as do all planets when near opposition. It will be in opposition on March 12. The earth passed through the plane of Saturn's rings for a second time within a few months on February 22 and is now on the same side of their plane as the sun. We see the bright side of the rings but at a very small angle. W. H. Pickering states that his observations of the rings lead him to believe that while the outer rings are extremely thin, as is well known, the crepe ring has a thickness of not far from 2,000 miles.

Uranus moves a degree and a half eastward in Aquarius during the month. Mercury will pass within 4′ of Uranus on the 25th. Neptune is slowly retrograding in Cancer.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Fitting the gage with a tiny brush expedites gaging operations

A Pilot Brush for Gages

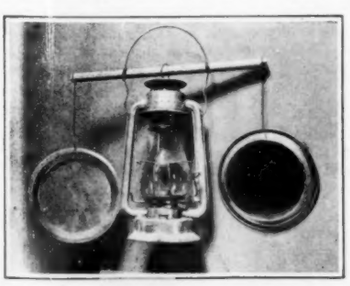
IN the practical use of fixed dimension gages the gage is used to test the accuracy of work. The article tested is frequently taken directly from the machine in which it was finished and the surface to be gaged is apt to be covered with oil, specks of dirt, chips or particles of abrasive material. Of course these foreign substances are detrimental to the gage surfaces, and to overcome such objections a Massachusetts manufacturer has brought out a pilot brush device which is used as a cleaner as well as a pilot. Gages are drilled and tapped to receive the brushes.

A New Use for Pie Tins

DEATH-DEALING baits, violent destruction by use of gun and dog, traps and other ensnarements, and even the building of a coyote-proof fence, are among the methods of arresting the encroachments of coyotes in the West, a predatory animal so destructive to domestic livestock. It remains, however, for a ranger of the United States Forest Service operating in Utah to employ a simple but clever method of "shooing" away the sneaking thieves of the cattle and sheep ranges.

Acting upon the theory that wild animals are suspicious of artificial illumination, lighted lanterns are stationed near bed grounds used by sheep in timber-line ranges of the National forests. These all-night beacons have their light-reflecting powers multiplied by suspending a new shining tin plate on each side of the lantern. This arrangement is effected by means of a rod tied to the handle of the lantern, made secure by insertion in the ring of the hood of the lighting fixture, the tin plates being suspended by strings from the ends of the rod.

The free swing of the coyote guard-lantern plates sends forth periodical flashes of illumination from the lantern which penetrate the darkness, throwing fright into the camp of the marauding pest whose stealthy invasions of sheep herds may be of nightly frequency. Other than reflecting a weird flash of light, a strong wind may serve to create a jangling noise. The ingenious forest official does not tell us how the guard-lantern plates operate in the absence of a wind. It is to be assumed, however, that the range of its effectiveness is somewhat controlled by the power of wind currents to keep in constant motion the light-reflecting plates.



This arrangement of a lamp and pie tins serves to drive away coyotes

Checking Up the Slip Gage

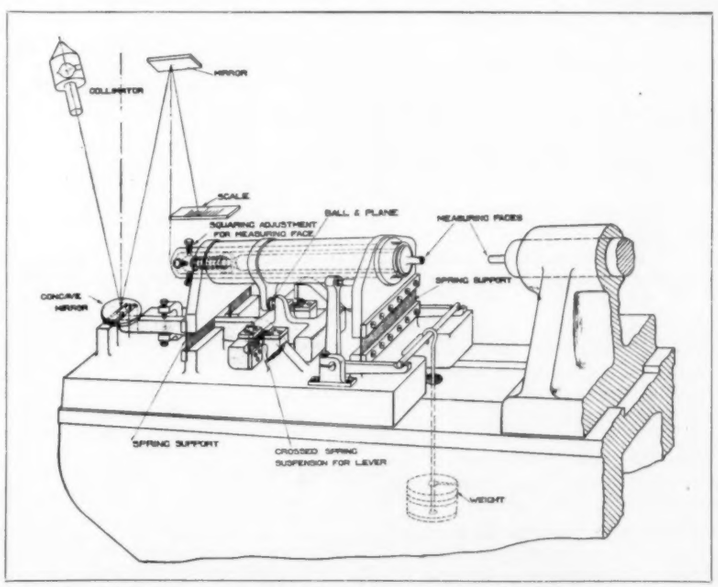
DESIGNED for making rapid and accurate tests on slip gages of the Johansson type, a device has recently been perfected by the National Physical Laboratory of London, England.

The bed of the machine carries two headstocks which are securely held down in position. The right-hand headstock carries a plunger which is lapped to be a good sliding fit in the bore and is held in position by two locking screws. The face of the plunger is flat and square to the axis of the plunger. The base of the left-hand headstock is screwed to the bed and supports a barrel by means of flexible steel strips at each end. This method of support allows the barrel to move slightly backward and forward in a direction parallel to the bed, its axis remaining always parallel to itself. The barrel is bored to carry a spindle, the right hand end of which forms the second measuring face of the machine. The spindle has a spherical-shaped collar at the right end which rests on a beveled facing at the end of the barrel, the contact being maintained by a spring placed inside the barrel. The barrel is bored to clear the spindle, the tail end of which is held between the points of two pairs of set screws placed at right angles and screwed into tongues at the rear end of the barrel. By adjustment of these set screws the spindle can be tilted on its spherical seating until the two measuring faces are brought accurately parallel. As the faces were required to be parallel to an order of a millionth of an inch, this adjustment needed to be very sensitive and was provided for by the spring action of the four tongue pieces in which the set screws were mounted.

The pressure between the measuring faces is derived from weights suspended by a rod hanging in a recess in the bed. The force is transmitted to the barrel by two bell-crank levers placed one on each side of it. The working pressure of the machine can be readily adjusted to any definite figure by varying the amount of the suspended weights.

To open the measuring faces for inserting a gage the barrel is moved slightly to the left on its flexible supports, by means of a lever. The lever is connected to a spindle carrying an eccentric disk which operates on a stop fixed to the lower part of the barrel. Having inserted a gage, the lever is turned to disengage the eccentric and the left-hand measuring face is automatically brought in contact with the gage by the action of the weights.

It is claimed that the machine will repeat its readings to within one-tenth of one scale division or one millionth of an inch, but to obtain such repetition extreme care has to be taken with regard to the cleanliness of the surface of the gages and of the measuring faces, and uniformity of temperature of the gage and the machine.



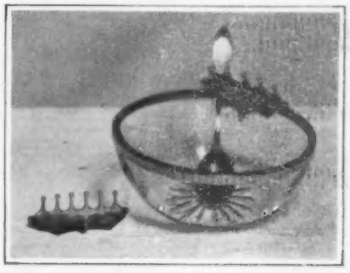
Details of the new apparatus designed by the National Physical Laboratory of London for rapid and accurate tests of slip gages

The Industrial Laundry

THE industrial laundry—what is it? Briefly, this is a department of the large plant which recovers lubricating oil from wipers and waste, and reclaims wiping and waste materials. Most of our leading industries are today conducting industrial laundries because it pays to do so. These industries are obtaining from 15 to 30 times the ordinary service from their wiping and cleaning materials. Many of them wash overalls, jumpers, towels and such for their employees, and at a profit. Indeed, this practice, so experts claim, produces wipers and waste at less than 3 cents a pound.

A Safe Haven for the Spoon

WHAT does the housekeeper in your family do when the spoon with which she is serving dessert slides blithely down into the bowl and gets submerged in the pudding or the peaches? Doubtless she does just what all other housewives have done under these circumstances for generations—fishes it out, disappears into the kitchen, and returns with the same spoon, washed, or with another one. The same accident occurs often to the individual in connection with his smaller spoon and smaller serving in a smaller bowl—with the same remedy. But a German haus-frau comes with the suggestion illustrated on this page, and designed to keep the spoon on its good behavior. As will be seen at once, the offending tool can slip neither sideways nor straight down; it must stay where it was put, reclining gracefully against the side of the dish, no matter how smooth and slippery the bottom on which its point rests.

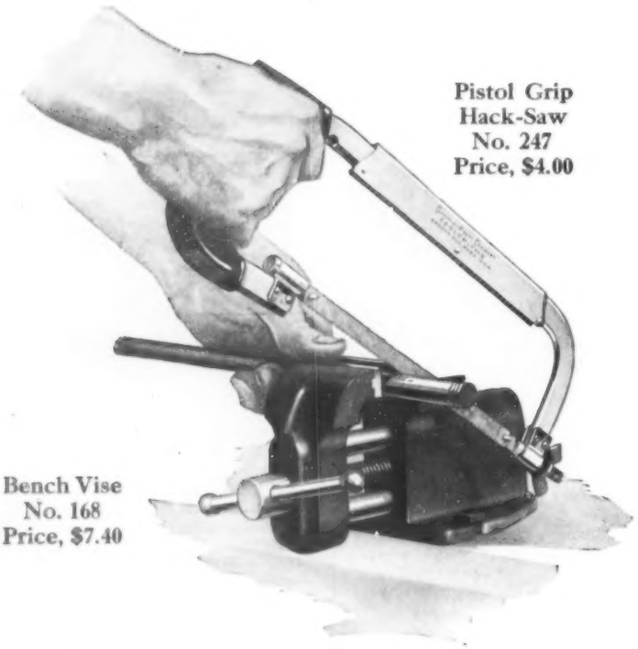


The non-disappearing-spoon holder — an idea from Germany

Still Another Power-Driven Ice Boat

THANKS to the variety of small gasoline motors now available, both new and second hand, there has been no end to the power-driven ice boats which have made their appearance during the past few winters. To the large collection of photographs of such craft which has already been published in our columns, we have the accompanying one to add. Here is the ice boat of David Jones of Peabody, Mass., which is said to make a speed of well over a mile a minute on smooth ice and without undue headwind. For a power plant, young Jones has made use of a discarded twin-cylinder motorcycle engine, which drives a tractor-screw propeller through a chain transmission. The front of the body rests on two fixed runners, while the rear is carried by a single pivoted runner which acts as the rudder. There are small supplementary runners fashioned out of steel rod on either side of the front runners, which serve to prevent the ice boat from turning over when rounding curves at high speed.

Ice boat equipped with twin-cylinder motorcycle engine



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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Apparel

WAISTBAND AND THE LIKE.—L. FRIEDMAN, 713 Broadway, New York, N. Y. The object of this invention is to provide a strip or band which is folded transversely forming buttonhole receiving portions, the buttonholes being formed through two thicknesses of material comprising the fold and the edges of said fold secured to the body of the strip and providing a finger receiving entrance at the side of the buttonhole.

Of General Interest

HAIR CURLER.—J. MORENILLA, Calle Boliva No. 21, Mexico, Mexico. This invention aims more particularly to provide a device of this nature which will not alone exercise a clamping action upon the hair, but will further, after such clamping action has been exercised, draw the hair into heated grooves so that a distinctly Marcel wave will result.

DUPLEX TUBE.—F. H. STEGATH, 420 Thompson St., Ann Arbor, Mich. The invention relates to tubes for containing liquid, semi-liquid or plastic matter. An object is to provide a duplex tube which may hold two preparations, so that both preparations may always be found together, and either of the preparations used without any danger of contamination with the other.

PILE AND PANEL SYSTEM FOR CONCRETE CONSTRUCTION.—C. G. DABIS, c/o Rock Island Hotel, Little Rock, Ark. An object of the invention is to provide a device which may take the place of caissons or coffer dams. A further object is to provide a subaqueous concrete construction which may be readily installed, and which when installed partakes of the nature of a monolithic structure.

HONEY-BEE FRAME INSPECTION STAND.—R. MUELLER, 449 Marlborough Rd., Yonkers, N. Y. This invention has reference more particularly to an inspection stand of the class indicated which is adapted to be thrust into the ground at any convenient place, and is adapted to support the honey bee brood frame. An object is to provide an inspection stand which will be simple and inexpensive to manufacture.

FOUNTAIN BRUSH.—W. GRACE, Hellaby's Bldg., Auckland, New Zealand. The invention relates to a device adapted to be embodied in brushes for various purposes, such as toothbrushes, shaving brushes and the like. More particularly the invention relates to a brush involving a reservoir or container adapted to receive a replaceable refill cartridge containing paste or other material to be delivered to the bristles through a hollow shank forming a conduit leading to the brush head.

PRINTED AND FOLDED SHEET.—S. BROWN, 38 Bedford St., Strand, London, W. C., England. The object of the invention is to provide a printed and folded sheet having at least three leaves or six pages and containing on each page printed matter, and arranged to enable the user to readily turn the leaves from the right to the left to successively bring to view the pages in proper sequence. Another object is to enable the user to open the sheet for reading page by page without spreading the sheet far apart.

LIGHT METER.—C. C. HOWENSTINE, 19374 Carman Ave., Highland Park, Mich. Among the objects of the invention is to provide a meter for determining the strength of light, it is particularly useful in taking photographs, to give the correct exposure for any diaphragm opening and any speed of plate or film; a further advantage is that the meter will operate as well, if not better, in weak interior light, as in strong light. The device is not restricted to photographic use, but may be employed in measuring light in buildings, stores, etc.

DISCHARGE MEASURING DEVICE FOR LIQUID RECEPTACLES.—W. P. BLAKE, Kirksville, Mo. The invention relates generally to liquid receptacles and particularly to a discharge measuring device for bottles, jars and the like, the object being the provision of an arrangement for measuring the discharges, as for instance in the case of dose regulation from medicine bottles.

COMBINED SHOE AND PUTTEE.—H. C. DYER, St. Luke's Rectory, East Elmhurst, L. I., N. Y. The invention relates to an arrangement in which the puttee is of the wrapped type adapted to engage the leg of the wearer in spirally arranged folds. The primary object is to provide a combination shoe and puttee in which the puttee is an integral part thereof, or the puttee may be produced from fabric instead of leather.

SIEVE.—E. J. OUELLETTE, 406 E. 4th St., Anaconda, Mont. The invention relates to ore concentrators or jigs, and has reference more particularly to a device of this kind comprising a frame, a strut extending across the frame, a screen disposed over the frame, and means connecting the screen and the strut whereby the latter obstructs no part of the screen, the struts being of the upward tapering cross-section form.

BOTTLE CASE AND SUPPORT.—C. J. CROSS, 140 Church St., New York, N. Y. An object of the invention is to provide a construction of case and support which is primarily designed in connection with bottles containing fire extinguisher, the device being especially adapted for use on automobiles, boats or other moving vehicles, and which will support the device so that it can be quickly used, and will cause the removal of the stopper with the removal of the bottle from its support.

PLASTIC COMPOSITION.—GUSTAVE EY, 158 5th Ave., Woodside, L. I., N. Y. An object of the invention is to produce a composition of matter which is inexpensive to make which has correct characteristics to adapt it to the manufacture of dolls, picture frames, statuettes or any model work of articles of commerce, the compound does not stick to molds during the manufacturing process. The composition comprises flour, glue, asbestos, cement, whiting, mixed with water.

TRUNK APPLIANCE.—H. S. CARSON, 5125 Kimbark Ave., Chicago, Ill. The object of this invention is to provide a support which may be utilized as an ironing board, a conventional table, or an invalid's table; the device is particularly adapted for use by people who travel; it may be carried in a conventional wardrobe trunk without any additional structure, or might form part of a closet or similar receiving department.

BRICK MOLD.—R. A. FONTAINE, c/o Am. Truck Body Co., Inc., Martinsville, Va. An object of the invention is to provide a mold which will constitute a combined mold and cutter, and which will simultaneously form a large number of bricks. A further object is to provide a mold which, when moved vertically, operates to cut the mud in the mold into a large number of standard size brick.

BOTTLE CLOSURE.—C. E. BLANCHARD, 3811 Cottage Grove Ave., Chicago, Ill. Among the objects of the invention is to provide a bottle closure which does not require to be cemented in the neck of the bottle, but which when inserted in the neck will, owing to its peculiar structure, cling to the neck so that when an attempt is made to remove the closure it will tear.

WRITING PAD.—G. R. CLARK, c/o Armour Co., Center Market, Washington, D. C. The invention has for its object to provide a writing pad which includes as one of the most important features an endless sheet of paper arranged to be advanced step by step, and capable of being reversed so that both sides of the paper may be filled with writing before it is discarded.

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Who Shall Work the Farms?—I

(*Continued from page 184*)

tality in the total number of farms operated, due directly to the labor shortage.

That one of the most drastic labor shortages which ever confronted American agriculture is today as firmly entrenched as the wolves of want during times of famine is known generally among the farmers. They are doing their best to meet and combat the emergency. By working longer hours in the field, by squeezing the last drop of efficiency out of daylight saving as applied and adapted to practical farm conditions, by the more intensive utilization of family labor, by decreasing the acreage of tilled crops, by renting out as much land as possible to reliable tenants competent to farm the land intelligently and well, by increasing their annual pasturage and green cover crop allotments which may be harvested by live stock and converted into valuable meat and dairy products, by using more and better fertilizers and heavier machinery—especially tractors; these farmers from Maine to Texas and from California to New Jersey have been doing their best to solve that contrary conundrum—the task of performing the work of four men with a force of three.

Conditions in Michigan are fairly representative of the dearth of farm workers which is prevalent in a number of the western states. Approximately 8.75 per cent of the farms—an aggregate area of about 1,000,000 acres equivalent to the combined acreage of five average counties—were idle in 1920. The total manpower available for working the land which is under cultivation consists of 230,000 male workers—many of whom are boys from 15 years of age and upward. This means that each of these men or boys had to handle 82.5 acres of farming land during the current season. A report as of May 15, 1920, issued by the Michigan Crop Reporting Service showed that 18,232 farms in the state were idle as compared with 11,831 in 1919. While this abandonment, which in many cases is temporary due to lack of tenant farmers, was least in the best farming sections, it is, without question, a community movement. Some districts show no abandonment. In other sections where the tendency to abandon the farm was originally of little consequence it has developed and has reached a point where from one third to one-half of the entire school district had migrated to the city.

Conservative figures evidence that 60 per cent of the farmers now actively operating farms in Michigan are over 50 years of age. The average size of the farms in the state is 91.5 acres and there are only 11 men and boys available for the running and managing of each ten farms. Right now there are 30,300 vacant houses on Michigan farms, 10,000 of which have been vacated during the last year. Of the 276,000 men employed on farms three years ago, 46,000 have since left the rural districts in order to gain the higher wages offered by the industrial concerns. Twenty thousand farm hands have migrated from the country to the city during the last 12 months. Under such conditions is it surprising that Michigan suffered a decrease of 15 per cent in the acreage of cultivation crops planted last season? The fact that the number of dairy cattle in the state declined 11.3 per cent indicates that milk producers are dispersing their herds because they cannot secure and retain the services of qualified and dependable helpers.

The writing on the wall is to the effect that the production of farm crops will decline as long as the present situation—featuring an abundance of work to be done and only a limited force to do it—continues and as long as the costs of producing crops correspond so closely to the market prices which the farmer receives. This simply means that the more the supply decreases, the higher the prices of foods will climb. The remedy for this abnormal condition is to curtail the numbers of non-producers of food and to multiply the ranks of the food producers. Such a reversal will result only when the remuneration for growing farm crops is proportionate to the incomes which obtain from other occupations and vocations that now yield attractive returns. It also features the countrywide need of markedly increasing the attractiveness of farm life in order that residence in the country will offer as many inducements to the average laborer as does city life.

Prospects are that inflated living costs will continue to a great extent. The labor shortage is vitally acute despite that the average wages paid country help are from 15 to 25 per cent higher than those of last year. This is sure to result in decreased production—unless you and I and everybody backs up the farmer; and not with extravagant encouragement and pats on the back but with actual sweat-of-the-brow and blistering-of-the-hands assistance. Uncle Sam has been collecting information from every highway and byway over his broad and productive farming territory. His summation of potential results in the bread-producing and meat-providing line run about in this wise: "Cultivation this year will be less intensive than formerly. More land will be put into grass and such other crops as require a minimum of labor. Land which the farmer cannot handle personally, he rents to tenants on the crop share or cash basis. In many instances the tenant is furnishing the labor only while the landowner provides everything else. The crop is split two-thirds to the latter and one-third to the former, or, some instances, on the fifty-fifty basis."

Various emergency measures have been suggested for the temporary relief of the farm-help famine. Proponents of unrestricted immigration have talked volubly and circumspectly about the benefits from a labor standpoint which would immediately result if the bars—which now protect our domestic laborers and keep out the worthy and nondescript of many foreign races which wish to flock to the United States—were let down. However to date, all these arguments and discussions have only exerted a smokeless powder, blank-cartridge effect on the farm-labor situation; and the chances are far from rosy that anything tangible will ever obtain from such sources.

The utilization of convict labor for emergency use on farms possesses more possibilities. However this would be largely a matter for state determination. Some states may favor the plan while others would be wholly against it. Were convict labor to be utilized, the prospects are that short term prisoners—offenders sentenced for terms of less than five years—would be principally used. It is this class that has largely composed the road gangs in the states where highway construction has been performed—to a greater or less degree—by convict labor. The greatest problem in the handling of convicts would consist in providing them with satisfactory guards and suitable lodgings. Tents such as are utilized by the road building forces could be used and the camp could be operated according to army discipline and practice. The transportation problem naturally would be of paramount importance and the division of the expenses among the various farmers who utilized such labor would also offer some perplexities. In the main, if convicts were used, they would have to be centralized for the most part in rather large units which would limit their services to the larger farms. A complete discussion of the convict-labor problem is impossible due to space limitations. It is a matter for state decision and adoption. However as a last resort if ade-

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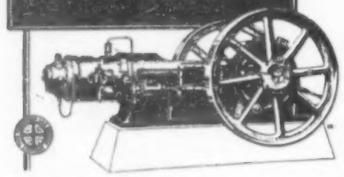

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quate working forces cannot be recruited from other channels, resort to convict labor will have to be made in some sections or else a material percentage of the land will remain uncropped.

The army of "floater" labor was of recent years greatly reduced in strength, due to the fact that this has been the era of employment when everyone who wants to work can secure plenty to do at profitable wages. Hence the influx into the grain-growing regions of the general run of transient labor which customarily has aided in harvesting has been measurably smaller than in former years. The lumber jacks, timber cruisers, fruit pickers and "hoboes" who heretofore have helped out at harvest time have largely transferred their temporary services to the industrial, manufacturing and commercial pursuits where the wages are more attractive and the hours are shorter. If the present industrial hesitation should persist throughout the summer of 1921, this situation would be made normal again; but no one expects it so to persist, so what we have said for 1920 will probably apply equally to 1921.

Farm women—the country over—have always been accustomed to aid as much as possible in the rush of warm weather work. Last year they did more than ever before. However, in the majority of cases they are useful only for the lighter forms of farm labor. On dairy farms, the women can help markedly by doing much of the milking, thereby permitting the men to put in longer days in the field. They also can tend the farm garden, run errands to town, deliver the milk and other dairy products to the railroad station, creamery or cheese factory. They can attend to the feeding of the live stock and perform the light farm chores. They can handle the farm poultry—as they have customarily done for many years. They also can accomplish invaluable work in the way of picking and packing fruits and vegetables. There are a hundred and one ways in which they can and their men folks so that the latter can devote their undivided attention to the growing and care of the crops. But as a general proposition they cannot do the heavy field work that constitutes the backbone of farming.

Salvaging Torpedo Boats for Peaceful Uses

(*Continued from page 185*)

and to act as convoys for troop ships. For nearly two years the destroyers met the exacting demands of real war service. Yet officials assert that the hulls are as rugged and tight as on the day they were put together. There has not been found the slightest sign of structural weakness in any of the vessels. If the need had arisen they could have gone to sea again. Now it is too late, for workmen with oxy-acetylene torches and chisels and steel drills have gone into the hulls and torn out the machinery. These boats were retired primarily because they are coal burners. The space available for coal bunkers was so small that their cruising radius was limited and they could not stay at sea so long as oil burning destroyers. It is a fact also that they were outclassed by the newer torpedo boats of the American Navy which turn up thirty-five knots an hour. But it should not be assumed from this that the old boats are slow. Even on the day of their retirement they were said to be good for an average of twenty-five knots each. The "Bainbridge," probably the fastest of the thirteen, turned up 28.5 knots on her trial trip.

The yard that is renovating these craft was established fifty years ago and now disposes of from thirty to fifty ships a year. In the yard at present, in addition to the torpedo boats, are the old Ward Liner "Seguranca," twice sunk during the war by German submarines, and the "Malabar," formerly H. M. S. "Terror," a troop and convict ship. This latter vessel is to be turned into an oil tanker. She had been tied up at Bermuda for thirty years, but is still seaworthy. Her towering sides, built to accommodate tier upon tier of decks containing hundreds of berths, are to be cut down and she will be plated over in the whaleback style.

The "Seguranca" was once in the transatlantic service and carried thousands of passengers. She was taken over for troopship service during the war and was caught by a torpedo the first time near Lisbon, Spain. When shipping became scarce as the toll of war grew, she was raised, repaired and put back into service only to be hit for the second time near Bermuda. Lying on the bottom in shallow water, she was sold to the junk man and salvaged. It has been found that her hull is still sound enough to repair, and it is likely that this boat will go back into passenger and freight service.

From the Einstein Contest—III

(*Continued from page 187*)

by a contraction of these same instruments in the direction of their motion. This contraction obviously cannot be observed directly because all bodies, including the measuring instruments themselves (which after all are only arbitrary guides), will suffer the contraction equally. According to this theory, called the Lorentz-Fitzgerald contraction theory,][272] all bodies in motion suffer such contraction of their length in the direction of their motion; [the contraction being made evident by our inability to observe the absolute motion of the earth, which it is assumed must exist.][272] This would suffice to show why the Michelson-Morley experiment gave a negative result, and would preserve the concept of absolute motion with reference to the ether.

[Now it will be clear that this explanation is a very *special* one; that is, it applies only to the particular experiment in question. And indeed it is only one of many *possible* explanations. Einstein conceived the notion that it might be infinitely more valuable to take the most general explanation possible, and then try to find from this its logical consequences. This "most general explanation" is, of course, that it is impossible in any way whatever to measure the absolute motion of a body in space.][273] Accordingly Einstein enunciated, first the Special Theory of Relativity, and later the General Theory of Relativity. The special theory was so called because it was limited to uniform rectilinear and non-rotary motions. The general theory, on the other hand, dealt not only with uniform rectilinear motions, but with any arbitrary motion whatever.

The hypothesis of relativity asserts that there can be no such concept as absolute position, absolute motion, absolute time; that space and time are interdependent, not independent; that everything is relative to something else. It thus accords with the philosophical notion of the relativity of all knowledge. [Knowledge is based, ultimately, upon measurement; and clearly all measurement is relative, consisting merely in the application of a standard to the magnitude measured. All metric numbers are relative; dividing the unit multiplies the metric number. Moreover, if measure and measured change proportionately, the measuring number is unchanged. Should space with all its contents swell in fixed ratio throughout, no measurement could detect this; nor even should it *pulse* uniformly throughout. Furthermore, were space and space-contents in any way systematically *transformed* (as by reflection in curved mirrors) point for point, continuously, without rending, no measurement could reveal this distortion; experience would proceed undisturbed.][268]

[Mark Twain said that the street in Damascus "which is called straight," is so called because while it is not as straight

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as a rainbow it is straighter than a corkscrew. This expresses the basic idea of relativity—the idea of *comparison*. All our knowledge is *relative*, not *absolute*, Things are big or little, long or short, light or heavy, fast or slow, only by comparison. An atom may be as large, compared to an electron, as is a cathedral compared to a fly. The relativity theory of Einstein emphasizes two cases of relative knowledge; our knowledge of *time and space*, and our knowledge of *motion*.][216] [And in each case, instead of allowing the notions of relativity to guide us only so far as it pleases us to follow them, there abandoning them for ideas more in accord with what we find it easy to take for granted, Einstein builds his structure on the thesis that relativity must be admitted, must be followed out to the bitter end, in spite of anything that it may do to our preconceived notions. If relativity is to be admitted at all, it must be admitted *in toto;* no matter what else it contradicts, we have no appeal from its conclusions so long as it refrains from contradicting itself.]*

The hypothesis of relativity was developed by Einstein through *a priori* methods, not the more usual *a posteriori* ones. That is, certain principles were enunciated as probably true, the consequences of these were developed, and these deductions tested by comparison of the predicted and the observed phenomena. It was in no sense attained by the more usual procedure of observing groups of phenomena and formulating a law or formula which would embrace them and correctly describe the routine or sequence of phenomena.

The first principle thus enunciated is that it is impossible to measure or detect absolute translatory motion through space, under any circumstances or by any means. The second is that the velocity of light in free space appears the same to all observers regardless of the relative motion of the source of light and the observer. This velocity is not affected by motion of the source toward or away from the observer, [if we may for the moment use this expression with its implication of absolute motion.]* But universal relativity insists that motion of the source toward the observer is identical with motion of the observer toward the source.

[It will be seen that we are at once on the horns of a dilemma. Either we must give up relativity before we get fairly started on it, or we must overturn the foundations of common sense by admitting that time and space are so constituted that when we go to meet an advancing light impulse, or when we retreat from it, it still reaches us with the same velocity as though we stood still waiting for it. We shall find when we are through with our investigation that common sense is at fault; that our fixed impression of the absurdity of the state of affairs just outlined springs from a confusion between relativism and absolutism which has heretofore dominated our thought and gone unquestioned.]*

[But it is obvious from what has just been said that if we are to adopt Einstein's theory, we must make very radical changes in some of our fundamental notions, changes that seem in violent conflict with common sense. It is unfortunate that many popularizers of relativity have been more concerned to astonish their readers with incredible paradoxes than to give an account such as would appeal to sound judgment. Many of these paradoxes do not belong essentially to the theory at all. There is nothing in the latter that an enlarged and enlightened common sense would not readily endorse. But common sense must be educated up to the necessary level.

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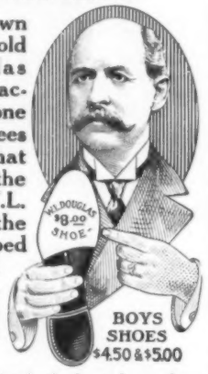

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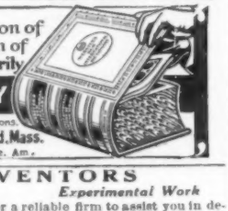

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trouble consisted in taking up-and-down as an invariable direction, a habit firmly implanted by long familiarity with a flat earth. Something similar afflicts us today. In all ordinary terrestrial matters we take the earth as a fixed body, light as instantaneous. This is perfectly proper, for such matters. But we carry our earth-acquired habits with us into the celestial regions. Though we have no longer the earth to stand on, yet we assume, as on the earth, that all measurements and movements must be referred to some fixed body, and are only then valid. We cling to our earth-bound notion that there *is* an absolute up-and-down, back-and forth, right-and-left, in space. We may admit that we can never find it, but we still *think it is there*, and seek to approach it as nearly as possible. And similarly from our earth experiences, which are sufficiently in a single place to make possible this simplifying assumption, we get the idea that there is *one* universal time, applicable at once to the entire universe.][10] [The difficulty in accepting Einstein is entirely the difficulty in getting away from these earth-bound habits of thought.]*

Making Weather to Order

(*Continued from page 188*)

ready for the oven and his success as a baker depended on his ability as a guesser. There were two reasons for his troubles: the varying humidity and the bacteria of the air both affected the raising dough. Conditioning the air not only makes it and keeps it just right for the yeast to work best, but it washes from the air all dirt and bacteria. Scientific tests have proven this latter statement. The modern baker makes his bread according to formula and instead of guessing when his bread is ready, looks at his watch and knows. Manufactured weather has been successfully applied in a number of industries where fermentation is a part of the process.

The air engineer has also made it possible to introduce quantity production methods into the woodworking industries, where, heretofore, each piece had to be cut and fitted individually. A piece made to fit today, a week hence would probably be either too big or too small as it had shrunk or swollen from atmospheric conditions. By keeping the air constantly at the same humidity the same quantity-production methods used in the metal industries are possible in wood-working. This fact was proved conclusively in the huge U. S. Naval Aircraft Factory at League Island, Philadelphia. The complete operation of building naval aircraft was carried out here in conditioned air and not only were manufacturing problems simplified, but the finished aircraft, leaving the factory with a uniform moisture content in its parts, contracted and expanded equally under outside weather conditions, resulting in a more reliable craft.

For years it has been considered almost impossible to manufacture fine chocolates in summer. Chocolates exposed to the heat and humidity of an ordinary summer day lose their rich dark brown color and silken "finish" and assume a pale tan shade. If the same chocolate were cooled and "set" as soon as it was dipped, it would retain its appearance and flavor, and if properly packed and kept would reach the consumer in perfect condition. Upon the old time assumption that the difference between summer and winter was merely a matter of temperature, it has been the practise of candy makers to install refrigerating coils in rooms where the chocolates were dipped. The air immediately surrounding the coils became too dry through condensation on them and the rest was too wet. Besides the coils were unsanitary, dangerous if a leak developed and they were not subject to automatic control. The automatic weather man has saved the day here, too, and in many modern candy factories the right brand of weather is made before it enters the factory and it is always right.

Three of the largest chewing gum factories now are equipped with air conditioning apparatus. Air at the right temperature and humidity and free from impurities contributes largely to a uniformly good product.

Manufactured weather has solved a rather knotty problem for the rubber manufacturer. The first process in treating the raw rubber is to wash it. It is reduced to sheets which must be dried before they can be further processed. The drying is done in a temperature warmer than ever the tropics produce but the rubber cannot be exposed to these high temperatures without injury unless the humidity is relatively high. Other systems are quicker but they injure the rubber, whereas if the proper atmosphere is supplied the rubber dries in a very few hours and it is actually improved in quality.

Mechanical weather is used in nearly every branch of the laboratory work of the motion picture industry from the drying of the celluloid film base to the drying of the finished films. Humidity has an interesting effect on film. If the air is too damp the film becomes opaque and if too dry, the film becomes brittle and cracks. The limit between the two conditions is very narrow and the use of conditioned air saves thousands of dollars' worth of valuable film.

The drying of macaroni and noodles presented particularly difficult technical problems which have been solved by air conditioning.

In one of the large tobacco factories where machines are used for stripping the stems from the tobacco leaves, the room in which this operation took place was so filled with injurious dust that one could hardly see its length. Of course the labor problem there was a very difficult one. When the weather engineer was called in, instead of trying to remove the dust he supplied enough humidity to keep the tobacco leaves from getting brittle and prevented the formation of the dust. Now air conditioning has been introduced into all branches of the tobacco industry in which weather has always been a large factor, with a resultant saving of thousands of dollars each year.

Before the mechanical weather man invaded his field the manufacture of electrical insulators and other ceramic materials used to stand a loss of between 20 and 35 per cent in his "green" pieces spoiled in the drying. This loss has been reduced to between 2 and 5 per cent.

Certain chemical processes in which temperature and humidity are factors, notably the making of ammonium nitrate for explosives, have not only been speeded but made practicable on a large scale by air conditioning. Other interesting applications to which many pages could be devoted are in preventing static electricity in printing newspapers and magazines, in the manufacture of paper, in the making of medical capsules, etc.

But undoubtedly the largest application is yet to be made; that is for non-industrial purposes—in the homes, schools, churches, theaters, office buildings, etc. Mr. Willis H. Carrier, to whose foresight and engineering skill the art owes much of its present status, is a firm apostle of the thought that good weather in the home is just as essential as in the industries.

"You'd laugh at a house without a heating system," says Mr. Carrier, "and yet such a house would be no more absurd than a house without a cooling system. Why should we regard summer as a time when we must simply grin and suffer from the heat, any more than we should regard winter as a time when we must smile cheerfully and suffer from the cold?

"As a matter of fact the installation of equipment for manufacturing cool weather in the summer, also provides better warm

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Air Plus Oil Equals More Oil

(*Continued from page 190*)

the deep-seated oil sand under pressures ranging from 40 to 300 pounds. These are termed "air wells" to distinguish them from the other wells from which the resultant oil is pumped in the usual fashion. The apparatus required is comparatively simple. In the main it consists of an air compression driven by a gas engine which may be from 20 to 100 horsepower—the choice being determined by the quantity of air to be delivered underground and by the pressure needful to stimulate the movement of the oil. The air is piped from the compressor to the wells chosen, and there the line is connected with the metal casing or tubing which extends to the bottom of the drill hole and into the oil sand. At a suitable point down in the hole an air-tight collar of cement is formed to prevent the air from rising surfaceward through the unfilled drill-hole. With everything ready, the compressor is started; and, if the proper precautions have been taken, the pressure of the air accumulating under ground will fill the space previously occupied by the natural gas.

The engineering problem is to see to it that the air gets into all parts of the sand where there is petroleum and to prevent the air from being lost or wasted by reaching into areas where there is little if any soil. As might be expected, the air tends to follow the easiest and shortest route between its points of discharge from the air wells and the avenues leading upward by way of the pumping wells. It is practicable so to regulate the flow of the oil surfaceward in the pumping wells as to set up back pressures—much like the condition induced by holding in restraint natural gas when present. This procedure enables the operator to build up the subterranean pressure and thus to effect the distribution of the air throughout the oil sand.

Sometimes so-called "tight" sands are intermingled with those of an open character, and if the air pressure were not distributed, as in the manner just described, then the expulsive medium would short circuit around these less yielding beds and fail to drive out of them the oil with which they may be laden. On the other hand, if the oil sands are principally of a compact nature, the petroleum could not be recovered in paying quantities unless means were taken to maintain a satisfactory back pressure for the purpose of inducing a complete penetration of the air. Petroleum in a tight sand migrates slowly, and this movement is further influenced by the density of the oil and the percentage of its paraffin content.

The favorable outcome, when compressed air is used, depends to a considerable extent upon the choice of the wells through which the air is to be forced downward. It is essential that these wells be so placed or circumstanced as to reduce to a minimum the likelihood of the air being wasted by running off into neighboring formations that would facilitate its dissipation. Having decided that it is worth while to try compressed air upon a given area with which the operator is conversant geologically, his next step is to determine the size of the compressor plant commensurate with the local requirements. In the Appalachian oil fields this is done by using a handy five-horsepower portable testing compressor. In this way, it is possible to learn how

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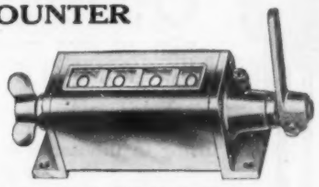

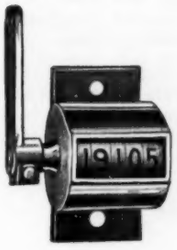

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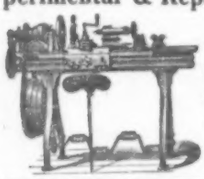

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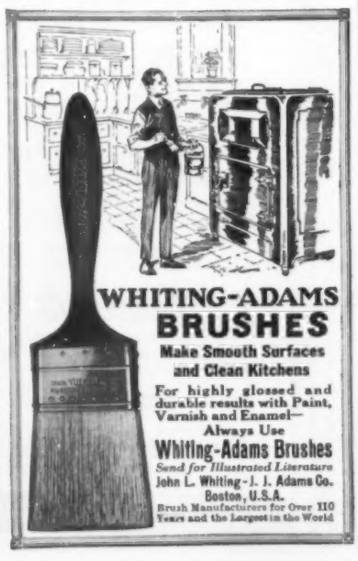

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much air the sand will take and also to discover what pressure is needful to induce initial absorption of the air, for it is a fact that the sands are all of them more or less resistant. Finally, having found out the maximum pressure at which the sand will drink in all of the air that the testing plant can deliver, it is a comparatively easy matter to fix upon the proper installation.

Taking the results generally, an average of 10,000 cubic feet of free air is pumped into each well daily. That is to say, if there is one air well and three oil wells, 40,000 cubic feet of air must be forced under ground every twenty four hours. The measure of power for this service is determined directly by the perpendicular thickness of the sand. The time elapsing before an increase in oil production is noted may vary all the way from less than a week to a period of months, and for this reason an operator should not be discouraged if he reaps no immediate gains. The underground conditions and the extent of the area he is seeking to influence will have their several effects upon the outcome. Even so, as already pointed out, the results in a large percentage of the installations richly compensate for the expense involved.

The layman must not imagine that the favorable displacement or movement of the petroleum is accomplished after the fashion of the urge of a solid body of water carrying and lifting the mass of oil. The compressed air mingles with the petroleum, creates an oleaginous froth, and this progressively breaks its way through the sand toward the intakes of the pumping wells. This commingling of the air with the oil does not, contrary to the fears of some operators, hurt the ultimate commodity in any way. There is no doubt, however, that the air will dilute the natural gas where this is present, and this dilution may diminish the value of the gas as a source of energy for gas engines or as a medium for heating purposes. Even so, the impairment of the natural gas as a fuel is offset by the returns from the increased output of petroleum.

As an alternative in stimulating the yield of oil, the practice has been encouraged of flooding the wells in some of our oil fields—relying upon the rising tide of the water to lift or to drive the petroleum toward the pockets or shot holes at the bottom of the wells. This procedure has undeniably augmented the flow of oil by a few barrels daily, but it also tends to waterlog the oil sand more or less completely and may damage neighboring properties. On the contrary, compressed air does not bring about the same serious or permanent underground changes and, broadly stated, it would seem that the compressed-air method costs less and gives richer results as a rule than flooding. In conclusion, there is warrant for the belief that the compressed-air process may yet enable us to add to our domestic oil supply anywhere from six to twelve billion barrels of petroleum that otherwise would remain underground.

The Papaya, or Tree Melon

(*Continued from page 191*)

est by fire or otherwise, the papaya often springs up from seeds dropped by birds. Small groups are commonly found growing about huts, where they seem to thrive without any cultivation whatever. In Hawaii, almost any well-drained soil seems to be suitable, but, ordinarily, rich loam or humus on a hillside is the soil that the papaya likes best.

Since the plant is filled with moisture, it flourishes in regions where there are heavy rains every day and high temperatures both day and night. In California, the nights are too cool for it. In favorable soils and climates, it grows rapidly and with great luxuriance, sometimes fruiting in seven months from seed and bearing in a single season from twelve to sixty fruits weighing five to twenty pounds apiece. This enormous yield is almost continuous for about three years, after which the tree steadily deteriorates.

It is to be hoped that, with improved conditions of cultivation, the papaya will soon become much more common in our markets, as it deserves to be because of its agreeable flavor, its importance as a food, and its value in combating that American disease, dyspepsia.

Most of the accompanying illustrations are made from photographs taken by Mr. Nelson Popenoe at the Plant Introduction Field Station, Miami, Fla.

The Trumpeter Swan

(*Continued from page 191*)

ber ranging from 1,312 in 1854 to 122 in 1877. It is now put down by naturalists as very rare, anywhere within its former range. While the breeding range was limited to the interior of Canada, in winter, it was distributed south from the limit of open water through the western United States to Texas and South Carolina. On the Pacific it was common from central British Columbia to southern California. In 1915 Coale, the American naturalist, notes that "of the great number of trumpeter swans which traversed central and western North America sixty years ago, there are only 16 specimens preserved in museums which have authentic data."

The British Columbia colony was first located upon about a year ago by a local ornithologist. As soon as it came to the knowledge of the Dominion Parks Commissioner a guardian was put over the birds. The exact location of the colony has not been divulged. The lake where they were found is open all the year around and it is stated that the swans do not go south, nor indeed, do they leave Canada at all. They go north in summer, but their range of migration is extremely limited. Efforts are now being made to locate exactly their summer habitat.

As many as one hundred have been counted in the colony, and the Dominion Parks Branch has succeeded in securing motion pictures of 19 of them. The problem now before the Government is whether these remaining members of an almost extinct but extremely interesting species of North American water-fowl can be preserved. A determined effort in this direction is being made and it is hoped that it may be as successful as the handling of the buffalo, which are now becoming so numerous on the Canadian range at Wainwright as to be embarrassing.

The description given of the swans shows conclusively that they are genuine trumpeters. They are pure white in color and very large. Although they have not been handled, those who have observed and photographed them put the extreme length of the largest of them at between 5 3/4 and 6 feet, and their height, standing, at between 3½ and 4 feet, while their weight is estimated at around 30 pounds. The sonorous voice, resembling the notes of the French horn, which has given them their name, is understood to have first led to the discovery of the present colony.

The naturalist's notes on them are interesting. They are stated to be distinguished from the whistling swan by their larger size, and other particulars. Their bills are entirely black, longer and narrower than those of the whistling swan, with the nostrils placed farther back, and, of course, there is a pronounced difference in the note of the fowl. The nests of the British Columbia birds are large and built of hay, rushes, and feathers, carefully lined with feathers and down. The eggs are elliptical in shape, from two to six in a nest, and measures from 4 to 4½ inches by from 2½ to 2¾, being pure white in color with a rough surface. Their food consists of leaves and seeds besides water plants and insects.

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